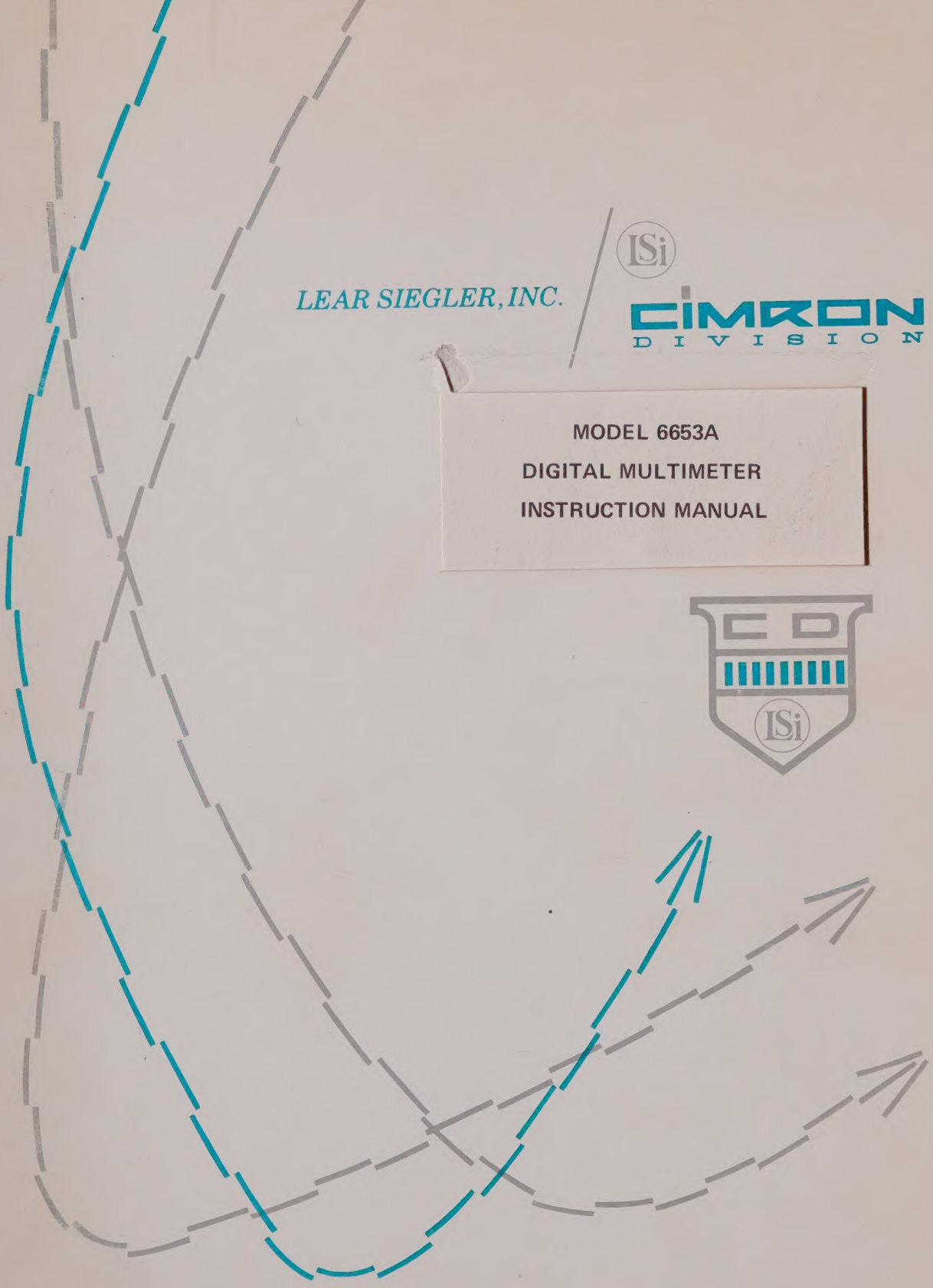

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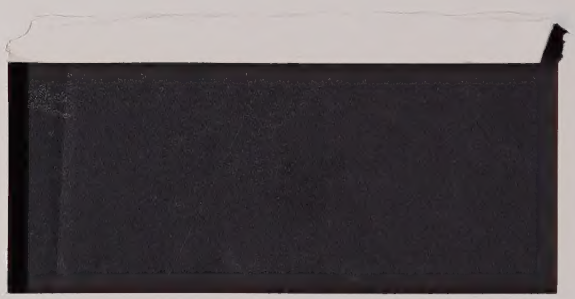

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MANUAL CHANGE

MANUAL AFFECTED: Model 6653A Digital Multimeter Instruction Manual

CHANGE NO. 3 **CHANGE DATE:** 2 June, 1972

REASON FOR CHANGE: To incorporate engineering and drafting changes.

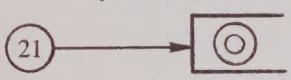
The changes contained in previous Manual Changes have been incorporated.

Pages 6-9/10, 6-19/20, 6-25/26, 6-41/42, 6-45/46, 6-63/64

In Figures 6-2, 6-4, 6-5, 6-9, 6-10, and 6-14 delete all numerals and parenthesis above encircled numbers.

Page 6-63/64

In Figure 6-14 identify the bracket Nixie board mounting (cut away to show R24) as follows:



Page 6-70

1. Opposite item 4: Under QTY REQD change 1 to 2. After C13 add C7.
2. Opposite item 8: Delete entire entry.

Page 6-73

In both figure 6-16 and schematic diagram: Change value of C7 to .47

Page 6-91/92

In Figure 6-20, to the left of Q7: Change R36 to R56.

Page 6-111/112

In Figure 6-25:
1. Upper left of Figure: Immediately underneath ZA2 add R3
2. Lower right of Figure: On S14 symbol change L17 to L14.

Pages 6-115/116 and 6-119/120

In Figures 6-26 and 6-27: Immediately above Q16 change R6 to R16

Page 6-130

Opposite item 10: Change CR1-CR17 to CR1-CR18

Page 6-134

Opposite item 8: Under QTY REQD change17 to 20. Change CR1-CR17 to CR1-CR20.

Page 6-139/140

In Figure 6-32: Change encircled 5 to 6 and encircled 6 to 5.

Page 6-145

Under SUBASSEMBLY Master Board and opposite item 5: Change 3 x 150 to 2 x 150

Page 6-148

In Figure 6-34 delete ④ and arrowed line.

Page 6-155

In upper left of diagram: Delete C1C, 150 μF and capacitor symbol.

TABLE OF CONTENTS

SECTION		PAGE
I	INTRODUCTION	1-1
	SCOPE	1-1
	GENERAL DESCRIPTION	1-1
	Basic Instrument Capabilities	1-1
	Instrument Capabilities With Accessories	1-2
	Fabrication	1-3
II	SPECIFICATIONS	2-1
	INSTRUMENT WITHOUT PLUG-IN ACCESSORIES	2-1
	INSTRUMENT WITH PLUG-IN ACCESSORIES	2-2
	Model 5676 AC Converter (50 Hz to 100 KHz)	2-2
	Model 5689 MV/Ohms Converter	2-3
	SAMPLE AND HOLD	2-5
III	OPERATING INSTRUCTIONS	3-1
	INSPECTION	3-1
	OPERATING CONTROLS, INDICATORS, AND CONNECTORS	3-1
	OPERATIONAL CHECKOUT	3-1
	Preliminary Procedure	3-6
	DC Voltage Measurement	3-6
	Millivolt Measurement	3-7
	Millivolts/Volts/Millivolts Measurement	3-7
	AC Voltage Measurement	3-8
	Resistance Measurement	3-8
	Ratio Measurement	3-9
	Print Output	3-10
	Remote Control	3-10
IV	CALIBRATION AND VERIFICATION OF SPECIFICATIONS	4-1
	GENERAL	4-1
	CALIBRATION PROCEDURES	4-1
	Basic DC Instrument	4-2
	MV/Ohms Converter Plug-In Accessory	4-4
	AC Converter Plug-In Accessory	4-5
	Sample and Hold Plug-In Accessory	4-7

TABLE OF CONTENTS (Cont'd)

SECTION		PAGE
IV	**CALIBRATION AND VERIFICATION OF SPECIFICATIONS (Cont'd)**	
	VERIFICATION OF SPECIFICATIONS	4-7
	Accuracy	4-7
	DC Resolution and Sensitivity	4-11
	Input Resistance	4-11
	Common Mode Rejection	4-12
	Normal Mode Rejection	4-13
V	**THEORY OF OPERATION**	5-1
	GENERAL DESCRIPTION	5-1
	BASIC SUCCESSIVE APPROXIMATION THEORY	5-1
	BLOCK DIAGRAM DESCRIPTION	5-2
	ASSEMBLY FUNCTIONAL DESCRIPTIONS	5-5
	Power Supply and Filter Assembly	5-5
	Input Selector Assembly	5-6
	AC Converter Assembly	5-7
	MV/Ohms Converter Assembly	5-7
	Input Amplifier Subassembly	5-10
	Program Control Assembly	5-13
	Decade Assembly	5-14
	Decoder Subassembly	5-15
	Reference Amplifier Assembly	5-16
	Conversion Timing Sequence	5-17
	Display Driver No. 2 Assembly	5-18
	Display Driver No. 1 Assembly	5-20
	Autorange Assembly	5-21
	Print Control Assembly	5-22
	1-2-4-8 Print Output Assemblies	5-24
	10-Line Print Output Assemblies	5-25
	Remote No. 1 Assembly	5-26
	Remote No. 2 Assembly	5-27
	Remote Buffers No. 1 and No. 2 Assemblies	5-27
	Sample and Hold Assembly	5-28
	Master Schematic Diagram	5-30
	INTERFACING	5-30
	Remote Programming	5-30
	Print Output	5-31

TABLE OF CONTENTS (Cont'd)

SECTION		PAGE
VI	**MAINTENANCE**	6-1
	GENERAL	6-1
	TROUBLESHOOTING AND REPAIR	6-1
	Decoder/Input Amplifier Assembly Repair	6-2
	Reference Amplifier Assembly Repair	6-2
	OPTIONAL ACCESSORIES INSTALLATION INSTRUCTIONS	6-2
	Converters, Autorange, Print and Remote Assemblies	6-2
	Rear Input Connector	6-3
	Input Selector Assembly	6-3
	Sample and Hold Assembly	6-3
	PARTS LISTS, PARTS LOCATION DIAGRAMS, AND SCHEMATIC DIAGRAMS	6-4
	Power Supply and Filter Assembly 66-6078	6-5
	Input Selector Assembly 66-6117	6-11
	Model 5676 AC Converter Assembly 57-6000	6-15
	Model 5689 MV/Ohms Converter Assembly 56-6014	6-21
	Decoder/Input Amplifier Assembly 66-5036	6-27
	Input Amplifier Subassembly 66-6116	6-27
	Program Control Assembly 66-6136	6-35
	Decade Assembly 66-6074	6-39
	Decoder Subassembly 66-6073	6-43
	Reference Amplifier Assembly 66-6112	6-47
	Display Driver No. 2 Assembly 66-6118	6-55
	Light Subassembly 66-6077	6-59
	Display Driver No. 1 Assembly 66-6075	6-59
	Autorange Assembly 66-6119	6-65
	Print Control Assembly 66-6137	6-69
	DTL Print Output No. 1 Assembly 66-6126	6-77
	DTL Print Output No. 2 Assembly 66-6127	6-81
	BCD Voltage State No. 1 (–12) Assembly 66-6128	6-85
	BCD Voltage State No. 2 (–12) Assembly 66-6129	6-89
	BCD Voltage State No. 1 (+12) Assembly 66-6121	6-93
	BCD Voltage State No. 2 (+12) Assembly 66-6122	6-97
	BCD Print Output No. 1 Assembly 66-6130	6-101
	BCD Print Output No. 2 Assembly 66-6131	6-105
	Ten-Line Print Output No. 1 Assembly 66-6123	6-109
	Ten-Line Print Output No. 2 Assembly 66-6124	6-113
	Ten-Line Print Output No. 3 Assembly 66-6125	6-117

TABLE OF CONTENTS (Cont'd)

SECTION		PAGE
VI	MAINTENANCE (Cont'd)	
	Remote No. 1 Assembly 66-6134	6-121
	Remote No. 2 Assembly 66-6135	6-125
	Remote Buffer No. 1 Assembly 66-6132	6-129
	Remote Buffer No. 2 Assembly 66-6133	6-133
	Sample and Hold Assembly 66-6115	6-137
	Master Assembly	6-141
VII	RECOMMENDED SPARE PARTS	7-1
	APPENDIX	A-1
	LIST OF ABBREVIATIONS AND SYMBOLS	A-2
	LIST OF MANUFACTURERS	A-3
	WARRANTY	

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
3-1	Operating Controls, Indicators, and Connectors	3-2
3-2	Buffered Remote Control Test Setup	3-11
3-3	Non-Buffered Remote Control Test Setup	3-12
4-1	Test Point and Adjustment Control Locations	4-2
4-2	Basic DC Instrument Calibration Test Setup No. One	4-3
4-3	Basic DC Instrument Calibration Test Setup No. Two	4-3
4-4	Millivolt Calibration Test Setup	4-4
4-5	AC Converter Calibration Test Setup	4-6
4-6	DC Measurement Accuracy Test Setup	4-7
4-7	Ratio Accuracy Test Setups	4-9
4-8	Input Resistance Test Setup	4-11
4-9	Common Mode Rejection Test Setup	4-13
4-10	Normal Mode Rejection Test Setup	4-14
5-1	One-Digit, Successive Approximation DVM Basic Block Diagram	5-2
5-2	Model 6653A Block Diagram	5-3
5-3	Millivolt Measurement Configuration	5-8

LIST OF ILLUSTRATIONS (Cont'd)

FIGURE	TITLE	PAGE
5-4	Resistance Measurement Configuration	5-9
5-5	Filter Response	5-12
5-6	Sample and Hold Module Block Diagram	5-29
5-7	Sample and Hold Timing at 1 KHz Clock Rate	5-30
5-8	Print Mode 1 Operation	5-31
5-9	Print Mode 2, Single Print	5-31
5-10	Print Mode 2, With Auto Print	5-32
6-1	Rear Panel Input Connector Wiring	6-4
6-2	Power Supply and Filter Assembly	6-9
6-3	Input Selector Assembly	6-13
6-4	Model 5676 AC Converter Assembly	6-19
6-5	Model 5689 MV/Ohms Converter Assembly	6-25
6-6	Decoder/Input Amplifier Assembly	6-32
6-7	Input Amplifier Subassembly	6-33
6-8	Program Control Assembly	6-37
6-9	Decade Assembly	6-41
6-10	Decoder Subassembly	6-45
6-11	Reference Amplifier Assembly	6-51
6-12	Display Driver No. 2 Assembly	6-57
6-13	Light Subassembly	6-62
6-14	Display Driver No. 1 Assembly	6-63
6-15	Autorange Assembly	6-67
6-16	Print Control Assembly	6-73
6-17	DTL Print Output No. 1 Assembly	6-79
6-18	DTL Print Output No. 2 Assembly	6-83
6-19	BCD Voltage State No. 1 (–12) Assembly	6-87
6-20	BCD Voltage State No. 2 (–12) Assembly	6-91
6-21	BCD Voltage State No. 1 (+12) Assembly	6-95
6-22	BCD Voltage State No. 2 (+12) Assembly	6-99
6-23	BCD Print Output No. 1 Assembly	6-103
6-24	BCD Print Output No. 2 Assembly	6-107
6-25	Ten-Line Print Output No. 1 Assembly	6-111
6-26	Ten-Line Print Output No. 2 Assembly	6-115
6-27	Ten-Line Print Output No. 3 Assembly	6-119
6-28	Remote No. 1 Assembly	6-123
6-29	Remote No. 2 Assembly	6-127
6-30	Remote Buffer No. 1 Assembly	6-131
6-31	Remote Buffer No. 2 Assembly	6-135

LIST OF ILLUSTRATIONS (Cont'd)

FIGURE	TITLE	PAGE
6-32	Sample and Hold Assembly	6-139
6-33	End Item	6-147
6-34	Front Panel Subassembly	6-148
6-35	Rear Panel Subassembly	6-149
6-36	Rear Input Connector Assembly	6-150
6-37	Main Chassis Subassembly	6-151
6-38	Master Board Subassembly	6-152
6-39	Frame Subassembly	6-153
6-40	Power Transistor Subassembly	6-154

LIST OF TABLES

TABLE	TITLE	PAGE
3-1	Operating Controls, Indicators, and Connectors	3 3
3-2	Initial Setting of Instrument Front Panel Controls	3-6
5-1	Power Supply and Filter Assembly Outputs	5-5
5-2	Input Selector Assembly Inputs and Outputs	5-6
5-3	MV/Ohms Converter Assembly Inputs and Outputs	5-8
5-4	Input Amplifier Subassembly Inputs and Outputs	5-11
5-5	Program Control Assembly Inputs and Outputs	5-13
5-6	Decade Assembly Inputs and Outputs	5-15
5-7	Reference Amplifier Assembly Inputs and Outputs	5-16
5-8	Display Driver No. 2 Assembly Inputs and Outputs	5-19
5-9	Display Driver No. 1 Assembly Inputs	5-20
5-10	Autorange Assembly Inputs and Outputs	5-21
5-11	Print Control Assembly Inputs and Outputs	5-23
5-12	BCD Print Output Assembly Inputs	5-24
5-13	Remote No. 1 Assembly Inputs and Outputs	5-26
5-14	Remote No. 2 Assembly Inputs and Outputs	5-28
7-1	Recommended Spare Parts	7-1

LIST OF DIAGRAMS

SEQUENTIAL

NO.	TITLE	PAGE
1	Power Supply and Filter Schematic	6-9
2	Input Selector Schematic	6-13
3	Model 5676 AC Converter Schematic	6-19
4	Model 5689 MV/Ohms Converter Schematic	6-25
5	Input Amplifier Subassembly Schematic	6-33
6	Program Control Schematic	6-37
7	Decade Schematic	6-41
8	Decoder Subassembly Schematic	6-45
9	Reference Amplifier Schematic	6-51
10	Conversion Timing Sequence	6-53
11	Display Driver No. 2 Schematic	6-57
12	Display Driver No. 1 Schematic	6-63
13	Autorange Schematic	6-67
14	Print Control Schematic	6-73
15	Print Timing	6-75
16	DTL Print Output No. 1 Schematic	6-79
17	DTL Print Output No. 2 Schematic	6-83
18	BCD Voltage State No. 1 (–12) Schematic	6-87
19	BCD Voltage State No. 2 (–12) Schematic	6-91
20	BCD Voltage State No. 1 (+12) Schematic	6-95
21	BCD Voltage State No. 2 (+12) Schematic	6-99
22	BCD Print Output No. 1 Schematic	6-103
23	BCD Print Output No. 2 Schematic	6-107
24	Ten-Line Print Output No. 1 Schematic	6-111
25	Ten-Line Print Output No. 2 Schematic	6-115
26	Ten-Line Print Output No. 3 Schematic	6-119
27	Remote No. 1 Schematic	6-123
28	Remote No. 2 Schematic	6-127
29	Remote Buffer No. 1 Schematic	6-131
30	Remote Buffer No. 2 Schematic	6-135
31	Sample and Hold Schematic	6-139
32	Master Schematic	6-155

ALPHABETICAL

TITLE	NO.	PAGE
Autorange Schematic	13	6-67
BCD Print Output No. 1 Schematic	22	6-103
BCD Print Output No. 2 Schematic	23	6-107
BCD Voltage State No. 1 (–12) Schematic	18	6-87
BCD Voltage State No. 2 (–12) Schematic	19	6-91
BCD Voltage State No. 1 (+12) Schematic	20	6-95
BCD Voltage State No. 2 (+12) Schematic	21	6-99
Conversion Timing Sequence	10	6-53
Decade Schematic	7	6-41
Decoder Schematic	8	6-45
Display Driver No. 1 Schematic	12	6-63
Display Driver No. 2 Schematic	11	6-57
DTL Print Output No. 1 Schematic	16	6-79
DTL Print Output No. 2 Schematic	17	6-83
Input Amplifier Schematic	5	6-33
Input Selector Schematic	2	6-13
Master Schematic	32	6-155
Model 5676 AC Converter Schematic	3	6-19
Model 5689 MV/Ohms Converter Schematic	4	6-25
Power Supply and Filter Schematic	1	6-9
Print Control Schematic	14	6-73
Print Timing	15	6-75
Program Control Schematic	6	6-37
Reference Amplifier Schematic	9	6-51
Remote Buffer No. 1 Schematic	29	6-131
Remote Buffer No. 2 Schematic	30	6-135
Remote No. 1 Schematic	27	6-123
Remote No. 2 Schematic	28	6-127
Sample and Hold Schematic	31	6-139
Ten-Line Print Output No. 1 Schematic	24	6-111
Ten-Line Print Output No. 2 Schematic	25	6-115
Ten-Line Print Output No. 3 Schematic	26	6-119

SECTION I

INTRODUCTION

SCOPE

This instruction manual contains a description; specifications; inspection and operational checkout information; calibration and specification verifying procedures; theory of operation; and maintenance information, parts lists, and diagrams applicable to the Cimron Model 6653A Digital Multimeter.

GENERAL DESCRIPTION

The Model 6653A consists of a DC voltmeter and DC/DC volt-ratiometer basic instrument and optional accessories. The accessories, available in any combination, are:

1. One AC Converter Assembly
2. One MV/Ohms Converter Assembly
3. One Input Selector Assembly. (Required with items 1 or 2.)
4. One Autorange Assembly
5. One Print Control Assembly
6. Three 10-line or two 1-2-4-8 Binary-Coded-Decimal (BCD) Print Output Assemblies
7. Two Remote Assemblies or two Remote Buffer Assemblies
8. One Sample and Hold Assembly
9. Guarded Input Cable Assemblies
10. One rear panel Signal Input Connector
11. Mounting hardware (bench stand, rack-mounting brackets, or slide rails)

With the exceptions of items 10 and 11, all optional accessories are the "plug-in" type.

BASIC INSTRUMENT CAPABILITIES

The basic instrument can measure DC voltages and DC/DC voltage ratios. The input signal can be sampled from one to five times per second, including polarity changes. Successive approximation logic enables high-speed measurements.

Instrument functions, sampling rates, ranges, and degree of input signal filtering are selected manually by means of front panel controls. The instrument has a front panel display of four digits (five digits for 10% overrange), an input signal polarity indication, and a decimal point indication. The input signal polarity is detected automatically. Front panel lights indicate the instrument function that has been selected.

DC Voltage Measurement

The instrument can measure DC voltages from 0.000 to ±1099.9 volts in three full-scale ranges of 10.999, 109.99, and 1099.9.

DC/DC Voltage Ratio Measurement

The instrument can measure either +DC/–DC or –DC/–DC voltage ratios. Ratio is measured by comparing an unknown DC input voltage with a known external DC reference voltage. The external reference voltage can be any value from –1 volt to –10 volts. The ratio range is from .0000:1 to 109.99:1 in three full-scale ranges of 1.0999:1, 10.999:1, and 109.99:1.

INSTRUMENT CAPABILITIES WITH ACCESSORIES

The Model 6653A with any or all of the optional accessories has the capabilities and features of the basic instrument. In addition, with all the accessories, the instrument can:

1. Measure AC voltages, low-level DC voltages (microvolts), millivolts-to-volts-to-millivolts DC voltages, and resistance.
2. Automatically range through five ranges.
3. Provide a print output to drive an associated printer.
4. Store instantaneous value of an analog signal for one conversion.
5. When remotely controlled:
   a. Sample the input signal from one to 1000 times per second.
   b. Measure the ratio of AC voltage, millivolts, or resistance to a –DC external reference voltage.

All measurement functions, sampling rates, degree of filtering, and the print output can be manually or remotely controlled. Ranging can be manually, automatically, or remotely controlled.

AC Voltage Measurement

With an AC Converter Assembly installed, the instrument can measure AC voltages over a frequency range of 50 hertz to 100 kilohertz. Subject to the limitations set forth in Section II, the instrument can measure AC voltages from 0.000 to 750 volts in four full-scale ranges of 1.0999, 10.999, 109.99, and 1099.9.

Millivolt and Resistance Measurement

With a MV/Ohms Converter Assembly installed, the instrument can measure:

1. DC voltages from 0.000 to ±1099.9 millivolts in three full-scale ranges of 10.999, 109.99, and 1099.9.
2. Resistance from 0.000 to 10999. kilohms in five full-scale ranges of 1.0999, 10.999, 109.99, 1099.9 and 10999..

Millivolts-to-Volts-to-Millivolts DC Voltage Measurement

With MV/Ohms Converter and Autorange Assemblies installed, the instrument can range between low-level DC millivolt measurements and high-level DC measurements up to 125 volts. When the input signal exceeds 1099.9 millivolts, the instrument will range up to the DC measurement mode. When the input signal decreases to less than 1000.0 millivolts, the instrument will range down to the millivolt measurement mode.

Autoranging

With an Autorange Assembly installed, the instrument automatically selects the range which provides maximum resolution of the input signal.

Print Output

The instrument can provide either 10-line decimal contact closure or BCD print output, depending on the type of Print Output Assemblies installed. The print output can be either 0 to –12, 0 to +12, or +5 to 0 voltage state or 0 to –12 volt contact closure and provides four-digit numeral (five in overrange), range, polarity, when applicable, and instrument function information.

Remote Control

If isolation between a remote control unit and the Cimron instrument is not required, the instrument can be controlled directly through rear panel connectors and Remote Assemblies. If isolation is required, the instrument can be controlled through rear panel connectors and isolated contact closures mounted on Remote Buffer Assemblies.

Sample and Hold

With a Sample and Hold Assembly installed, using DTL Print Output No. 1 and No. 2 Assemblies or Remote No.1 and No.2 Assemblies, or both, the instrument allows the instant storage of an analog value with each external start pulse received.

AC Voltage, Millivolt, or Resistance Ratio Measurement

When remotely controlled, the instrument can measure ratios between input signals from AC, millivolt, or resistance sources and an external –DC reference voltage. When measuring AC/–DC or MV/–DC ratios, the external reference voltage can be any value from –1 to –10 volts. When measuring KΩ/–DC ratios, the external reference voltage must be –10.000 volts. The front panel readout decimal location must be controlled from the remote control unit.

FABRICATION

The instrument is 5.25 inches (13.34 cm) high, 17 inches (43.18 cm) wide, and 18.50 inches (46.99 cm) deep and fits in a standard rack. The maximum net weight of the instrument is 38 pounds (17.24 Kg) and the shipping weight is 52 pounds (23.59 Kg). The instrument is manufactured in accordance with the best commercial practices for material, parts, and workmanship.

The input signal leads are floating and isolated from the case, power line ground, and print output when print output is through isolated contact closures. A guard shield that may be driven externally is employed to ensure maximum input isolation and common mode rejection. Input may be floated up to 1000 volts DC or peak AC, provided the voltage between any pin on the input connector and the instrument does not exceed 1500 volts peak.

Virtually all components are mounted on plug-in printed circuit boards, providing ease in troubleshooting and maintenance not usually encountered in complex electronic equipment.

Solid state components are used almost exclusively, including the digital potentiometer switches and converter chopper. Input signal attenuation, filter switching, and reference voltage switching are accomplished by means of reed relays.

SECTION II

SPECIFICATIONS

NOTE

All accuracy specifications apply only after the instrument has been calibrated with equipment listed in Section IV.

INSTRUMENT WITHOUT PLUG-IN ACCESSORIES

MEASUREMENT ACCURACY

All ranges, 25°C ±5°C, no temperature coefficient.

Short Term (30 days):
±0.01% of full scale (FS)

Long Term (6 months):
±(0.01% of FS + 0.01% of reading)

TEMPERATURE COEFFICIENT

±0.002% of FS/°C

DC/DC RATIO ACCURACY

10-volt reference:	±(0.01% of FS + 0.01% of reading)
5-volt reference:	±0.02% of FS
2-volt reference:	±0.05% of FS
1-volt reference:	±0.1% of FS

MEASUREMENT RESOLUTION

0.01% of FS (1 digit)

RATIO RESOLUTION

$$0.01\%\ \text{of FS}\left(\frac{10}{\text{Reference Voltage}}\right)$$

SENSITIVITY

1 millivolt on the 10 range.

SAMPLE RATE

Front panel control:
1-5 samples per second including polarity change.

External control:
Zero to 1 KHz

SIGNAL INPUT RESISTANCE

10 Range:	>10,000 MEGΩ
100 Range:	>10 MEGΩ
1K Range:	>10 MEGΩ

RATIO INPUT RESISTANCE	10 Megohms minimum
EXTERNAL DC REFERENCE VOLTAGE RANGE	–1 VDC to –10 VDC
RESPONSE TIME	Digitizing with Polarity Change: 1 millisecond Range Change: 50 milliseconds per range under external control. 200 milliseconds with front panel control of sample rate. Settling time for full scale step: Filter Out 300 microseconds Med Filter 175 milliseconds Full Filter 450 milliseconds
COMMON MODE REJECTION	With 1000Ω unbalance in either lead– DC: 1,000,000:1 (120 dB) 60 Hz: 100,000:1 (100 dB)
NORMAL MODE REJECTION (60 Hz)	No Filter: 0 dB Medium Filter: 32 dB Full Filter: 70 dB
POWER REQUIREMENTS	105-125 or 210-250 Volts. 50-60 Hz (400 Hz optional)
OPERATING TEMPERATURE RANGE	0° to +50°C

INSTRUMENT WITH PLUG-IN ACCESSORIES

MODEL 5676 AC CONVERTER (50 Hz to 100 KHz)

CAUTION

Between 50 Hz and 20 KHz, do not apply more than 750V rms to the input signal connectors. Between 20 KHz and 50 KHz, do not apply more than 500V rms. Between 50 KHz and 100 KHz, do not apply more than 250V rms. Failure to observe this caution may result in damage to the instrument.

ACCURACY

All ranges 10°C-40°C
- 50 Hz-20 KHz:
  - ±(0.05% of FS + 0.05% of reading)
- 20 KHz-50 KHz:
  - ±(0.05% of FS + 0.2% of reading)
- 50 KHz-100 KHz:
  - ±(0.05% of FS + 0.5% of reading)

TEMPERATURE COEFFICIENT

0.005% of FS/°C

RESPONSE TIME

Digitizing:	1 millisecond
Range Change:	50 milliseconds (external control)
Settling Time (0.01%):	
No Filter	above 1 KHz, 40 milliseconds
Med. Filter	above 100 Hz, 200 milliseconds
Full Filter	above 50 Hz, 450 milliseconds

INPUT IMPEDANCE

1 MEGΩ shunted by <100 picofarads, on all ranges

COMMON MODE REJECTION

60 Hz and less: 80 dB with 1 KΩ unbalance in either lead

MODEL 5689 MV/OHMS CONVERTER

OHMS CONVERTER

ACCURACY

25°C ±5°C

Short Term (30 days):
- 1, 10, and 100 KΩ ranges:
  - ±(0.01% of FS + 0.01% of reading)
- 1,000 KΩ range:
  - ±(0.01% of FS + 0.03% of reading)
- 10,000 KΩ range:
  - ±(0.03% of FS + 0.05% of reading)

Long Term (6 months):
- 1, 10, and 100 KΩ range:
  - ±(0.02% of FS + 0.01% of reading)
- 1,000 KΩ range:
  - ±(0.02% of FS + 0.03% of reading)
- 10,000 KΩ range:
  - ±(0.05% of FS + 0.05% of reading)

TEMPERATURE COEFFICIENT

1, 10, and 100 KΩ ranges:	0.002% of FS/°C
1,000 KΩ range:	0.003% of FS/°C
10,000 KΩ range:	0.006% of FS/°C

MAXIMUM VOLTAGE ACROSS UNKNOWN RESISTANCE

20 VDC (out of range). Maximum current is 10 milliamperes on 1 KΩ range.

RESPONSE TIME

Digitizing: 1 millisecond
Range Change: 50 milliseconds (external control)
Settling Time (to 0.01%):
1, 10, and 100 KΩ ranges: 75 milliseconds
1,000 KΩ range: 100 milliseconds
10,000 KΩ range: 750 milliseconds

MILLIVOLTS PREAMPLIFIER

ACCURACY

25°C ±5°C

Short Term (30 days):
10.999 mV range:
±(0.02% of FS + 0.02% of reading)
109.99 and 1099.9 mV ranges:
±(0.01% of FS + 0.01% of reading)

Long Term (6 months):
10.999 mV range:
±(0.03% of FS + 0.02% of reading)
109.99 and 1099.9 mV ranges:
±(0.02% of FS + 0.01% of reading)

ZERO STABILITY

Less than 0.5 μV/°C after warmup

TEMPERATURE COEFFICIENT

10.999 mV range:
0.005% of FS/°C
109.99 and 1099.9 mV ranges:
0.004% of FS/°C

RESPONSE TIME

Digitizing: 1 millisecond
Range Change: 50 milliseconds (external control)
Settling Time (to 0.01%):
10.999 mV range: 350 milliseconds
109.99 and 1099.9 mV ranges: 60 milliseconds

INPUT RESISTANCE

10.999 mV range: 10 MEGΩ minimum
109.99 and 1099.9 mV ranges: 100 MEGΩ minimum

COMMON MODE REJECTION

	DC	60 Hz
10.999 mV range:	146 dB	134 dB
109.99 mV range:	126 dB	114 dB
1099.9 mV range:	106 dB	100 dB

SAMPLE AND HOLD

APERTURE TIME	50 Nanoseconds
APERTURE UNCERTAINTY	100 Nanoseconds
HOLD DECAY	1 mV/msec maximum
INPUT IMPEDANCE	Same as function selected
ACCURACY	Add ±0.01% Full Scale to Basic Specification

SECTION III

OPERATING INSTRUCTIONS

INSPECTION

The Model 6653A instrument is tested under severe environmental conditions prior to shipment. It is ready for immediate use upon receipt. Make the following checks, however, to ensure that the equipment has suffered no damage in shipment:

1. Inspect the shipping container prior to acceptance from the carrier. If damage to the container is evident, remove the instrument from the container and visually inspect for damage to instrument parts. Note any damage to the instrument and container on the carrier's receipt for the carrier's agent to sign. A claim for damage, with a copy to Cimron Division, Lear Siegler, Inc., must be filed with the carrier within 15 days following receipt of the instrument.

2. If damage is not apparent until after the instrument is accepted, a claim for concealed damage, with a copy to Cimron, must be filed with the carrier within 15 days following receipt of the instrument.

3. When a claim is filed against the carrier, all packaging material must be retained for inspection.

4. If the instrument is damaged in shipment, failure to file a claim against the carrier within the specified time, with a copy to Cimron, may nullify the warranty in the event damage is reported to Cimron at a later date.

OPERATING CONTROLS, INDICATORS, AND CONNECTORS

Instrument operating controls, indicators, and connectors are located on the front and rear panels, as illustrated in figure 3-1.

Table 3-1 lists the operating controls, indicators and connectors and describes the function of each. Schematic reference designations are as shown on the Master Schematic Diagram.

NOTE

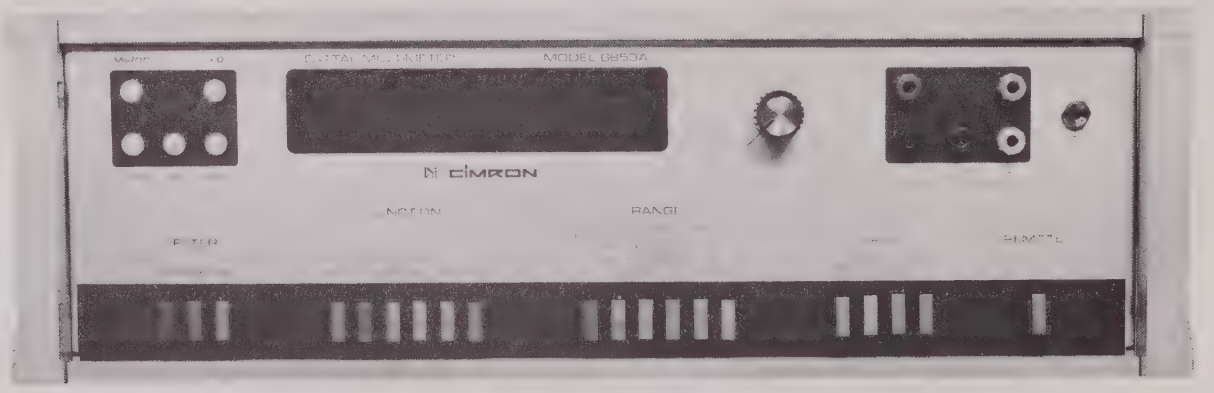
The liability of Cimron under the warranty is negated if the instrument is improperly repaired. If trouble is experienced during the operational checkout, refer to the appendix for warranty instructions before attempting repair.

OPERATIONAL CHECKOUT

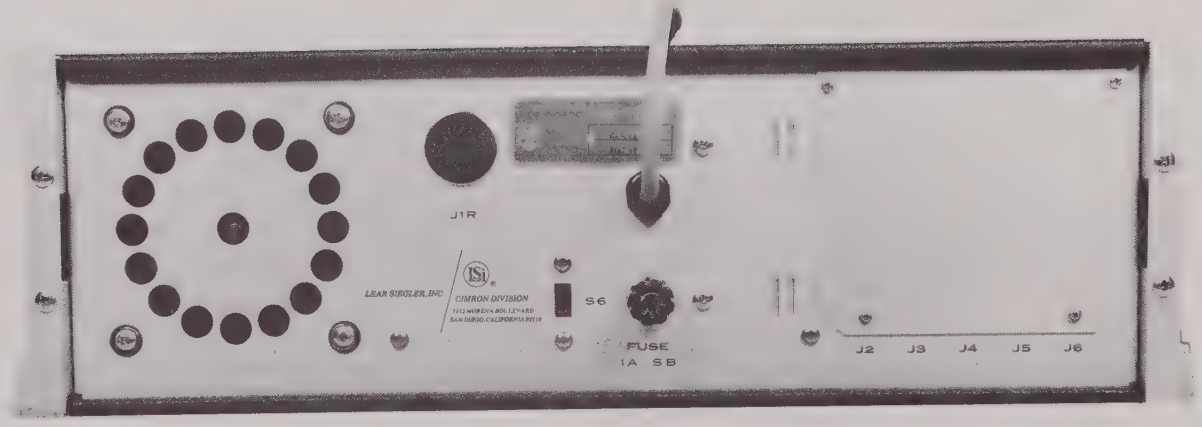
The operational checkout is intended as a preliminary test of operation and not to verify performance specifications. The checkout procedure assumes that all optional equipment is included in the Model 6653A instrument. Omit procedural steps that apply to optional capabilities not included in the instrument.

The following test equipment is required to perform the checkout:

1. Ten-volt battery
2. DC source with a range of 1 millivolt to 1000 volts
3. AC voltage source with 1 to 500 volts output at 50 Hz to 20 KHz
4. Resistance box with 1K, 10K, 100K, 1 MEG, and 10 MEGOHM resistors
5. Printer suitable for use with the Model 6653A
6. Oscilloscope
7. Two Amphenol No. 57-10500 50-pin connector receptacles



A. Front Panel.



B. Rear Panel

Figure 3-1. Operating Controls, Indicators, and Connectors.

Table 3-1. Operating Controls, Indicators, and Connectors.

CONTROL, INDICATOR OR CONNECTOR	POSITION OR CONDITION	FUNCTION
	FRONT PANEL	
MV/DC Indicator (DS1)	Illuminated	Indicates instrument measuring millivolts.
KΩ Indicator (DS5)	Illuminated	Indicates instrument measuring resistance.
V/DC Indicator (DS2)	Illuminated	Indicates instrument measuring DC voltage.
AC Indicator (DS3)	Illuminated	Indicates instrument measuring AC voltage.
RATIO Indicator (DS4)	Illuminated	Indicates instrument measuring ratio.
MV Zero (Screwdriver Adjustment R2)	Variable	In MV measuring function with input leads shorted, enables adjusting front panel numeral indication to all zeros.
KΩ Zero (Screwdriver Adjustment R1)	Variable	In the KΩ measuring function with input leads shorted, enables adjusting front panel numeral indication to all zeros.
±Indicator (B1DS1)	Illuminated	Indicates input signal polarity in DC, MV, or RATIO modes.
Numeral Indicators (B1DS2 thru B1DS6)	Illuminated	Indicate input signal value. The most significant digit is either blank or 1, and is provided only for 10% overrange indication.
Decimal Indicators		
	X.XXXX	1 KΩ, 1:1 ratio ranges, 1 VAC.
	XX.XXX	10 KΩ, 10:1 ratio, 10 VDC, VAC, or MV ranges.
	XXX.XX	100 KΩ, 100:1 ratio, 100 VDC, VAC, or MV ranges.
	XXXX.X	1000 KΩ, 1000 VDC, VAC, or MV ranges.
	XXXXX.	10,000 KΩ range.
POWER-RATE (Switch-Potentiometer S1)	Variable	When in OFF position, power is removed from instrument. When fully clockwise, the sampling rate is approximately 5/sec. As control is rotated counterclockwise, sample rate is reduced toward minimum of approximately 1/sec.
HI(Connector E1) and LO (Connector E2)		Connects input signal to Input Selector Assembly if installed, or else to Input Amplifier Assembly.

Table 3-1. Operating Controls, Indicators, and Connectors (Cont'd)

CONTROL, INDICATOR OR CONNECTOR	POSITION OR CONDITION	FUNCTION
GUARD (Connector E3)		When connected to signal source, terminates instrument guard shield at signal source.
+ (Connector E4) and − (Connector E5)		Connects external reference voltages to Reference Amplifier Assembly.
⏚ (Lug and Banana Jack)		Enables connection of external source to instrument power-line ground.
FILTER (Pushbutton Switch S2)		
OFF	Depressed	Normal mode rejection zero dB.
MED	Depressed	Normal mode rejection 32 dB at 60 Hz.
FULL	Depressed	Normal mode rejection 70 dB at 60 Hz.
FUNCTION (Pushbutton Switch S3)		
DC RATIO	Depressed	Enables DC ratio measurement.
DC V	Depressed	Enables DC voltage measurement.
DC V/MV	Depressed	When RANGE AUTO switch is depressed: 1. Enables DC measurements down to 1.000 volt then instrument ranges down to MV. 2. Enables MV measurements up to 1099.9 millivolts then instrument ranges up to V.
DC MV	Depressed	Enables DC millivolt measurement.
KΩ	Depressed	Enables resistance measurement.
AC	Depressed	Enables AC voltage measurement.
RANGE (Pushbutton Switch S4)		
1	Depressed	Sets instrument to 1 VAC and 1 KΩ ranges.
10	Depressed	In ratio function: Sets instrument to 1:1 range. In measurement function: Sets instrument to 10 mV, 10 VDC and AC, and 10 KΩ range.
100	Depressed	In ratio function: Sets instrument to 10:1 range. In measurement function: Sets instrument to 100 mV, 100 VDC and AC, and 100 KΩ range.
1K	Depressed	In ratio function: Sets instrument to 100:1 range.

Table 3-1. Operating Controls, Indicators, and Connectors (Cont'd).

CONTROL, INDICATOR, OR CONNECTOR	POSITION OR CONDITION	FUNCTION
1K (Cont'd)		In measurement function: Sets instrument to 1000 mV, 1000 VDC and AC, and 1000 KΩ range.
10K	Depressed	Sets instrument to 10,000 KΩ range.
AUTO	Depressed	Enables automatic ranging in all functions.
PRINT (Pushbutton Switch S5)		
OFF	Depressed	Enables instrument to measure input signal without issuing printouts. This switch MUST be depressed when printouts are not desired or when instrument does not have printout assemblies installed.
AUTO	Depressed	Controls sampling rate and causes a printout after each conversion.
HOLD	Depressed	Disables instrument
FORCE	Momentary Depress	Forces one printout. Instrument then returns to HOLD.
REMOTE (Push On-Push Off S7)	Depressed	Enables remote control of instrument. Disables all front panel controls except POWER/OFF-RATE. The RATE control is disabled when PRINT AUTO or HOLD is remotely programmed.
REAR PANEL		
115/230V (Slide Switch S6)		Enables operation of instrument on 105-125 or 210-250 volts 50-60 Hz.
J1R		Connected in parallel with front panel SIGNAL and REFERENCE input connectors.
J2		Connects Print Output No. 1 to external printer.
J3		Connects Print Output No. 2 to external printer.
J4		Connects Print Output No. 3 to external printer.
J5		Connects remote control input to Remote Assembly No. 1.
J6		Connects remote control input to Remote Assembly No. 2.

PRELIMINARY PROCEDURE

NOTE

In the optional Cimron guarded input cable, the red and black leads of the cable are the signal input leads. The green lead is used to terminate the instrument guard shield at the signal source. Whenever applicable, the green lead should be connected to the center of the source impedance. At all other times the green lead should be connected to the black lead. The yellow and blue leads are the external DC reference voltage leads.

1. Insert the input cables into the front panel connectors, matching lead color to connector color. Connect the red and black leads together.

2. Position the rear panel line voltage switch to 115 or 230, dependent on the power source available.

3. Insert the power plug into a three-wire, 105-125 or 210-250 volt, 50-to-60 hertz power source.

4. Set the instrument front panel controls to the positions indicated in table 3-2. Observe that the DC function indicator is illuminated. To expedite the checkout procedure, changes in instrument front panel controls and test equipment settings should be made only as directed in the checkout procedural steps.

Table 3-2. Initial Settings of Instrument Front Panel Controls.

CONTROL	POSITION
POWER/RATE	FULLY CLOCKWISE
FILTER	OFF
FUNCTION	DC V
RANGE	AUTO
PRINT	OFF

NOTE

Prior to performing step 5, allow a 30-minute warmup period.

NOTE

Zero indications may not be within specification during the operational checkout. If the numerical readout fluctuates, depress the FILTER MED or FILTER FULL control and adjust the POWER-RATE control to stabilize the readout, then depress the FILTER OFF control.

5. Observe that the instrument front panel numeral indication is 0.000.

6. When performing the operational checkout, in each step where the value of the input signal is changed observe that the instrument indicates the change.

DC VOLTAGE MEASUREMENT

Manual Range and Polarity Change

1. Depress the RANGE DC 10 switch. Adjust the DC source for 10-volts output. Connect the source to the Model 6653A instrument red and black input leads. Observe that the instrument indicates the polarity and value of the input signal.

2. Depress the instrument RANGE DC 100 switch. Adjust the DC source for 100-volts output.

3. Depress the RANGE DC 1K switch. Adjust the DC source for 1000-volts output.

4. Adjust the DC source for 100-volts output. Depress the instrument RANGE DC 100 switch.

5. Adjust the DC source for 10-volts output. Depress the instrument RANGE DC 10 switch.

6. Reverse the red and black input connections to the DC source. Observe that the instrument indicates the polarity change.

Automatic Ranging

1. Depress the RANGE AUTO switch. Increase the DC source output from 10 to 100 and then to 1000 volts while observing that the instrument front panel decimal indicator shifts from XX.XXX to XXX.XX and then to XXXX.X.

2. Decrease the DC source output from 1000 to 100 and then to 10 volts while observing that the decimal indicator shifts from XXXX.X to XXX.XX and then to XX.XXX.

3. Disconnect the DC source from the instrument. Connect the instrument red and black input leads together.

MILLIVOLT MEASUREMENT

Manual Ranging

1. Depress the RANGE MV 10 and FUNCTION DC MV switches. Observe that the MV/DC function indicator is illuminated.

2. If the front panel numeral indication is not 0.000, vary the front panel MV ZERO adjustment to obtain 0.000.

CAUTION

To avoid opening the fuse in the DC preamplifier input circuit, do not apply more than 125 volts to the red and black input leads when the FUNCTION DC MV or V/MV switches are depressed.

3. Adjust the DC source for 10-millivolts output. Connect the source to the instrument red and black input leads.

4. Depress the RANGE MV 100 switch. Adjust the DC source for 100-millivolts output.

5. Depress the RANGE MV 1K switch. Adjust the DC source for 1000-millivolts output.

6. Adjust the DC source for 100-millivolts output. Depress the RANGE MV 100 switch.

7. Adjust the DC source for 10-millivolts output. Depress the RANGE MV 10 switch.

8. Reverse the red and black input connections to the DC source. Observe that the instrument indicates the polarity change.

MILLIVOLTS/VOLTS/MILLIVOLTS MEASUREMENT

Automatic Ranging

1. Depress the RANGE AUTO and FUNCTION DC V/MV switches.

2. Vary the DC source output from millivolts to volts and back to millivolts while observing that:

   a. When the input signal is 1000.0 millivolts or less the front panel MV/DC function indicator is illuminated.

   b. When the input signal exceeds 1099.9 millivolts the MV/DC function indicator is extinguished and the V/DC function indicator is illuminated.

   c. When the input signal is reduced to less than 1.000 volt the V/DC function indicator is extinguished and the MV/DC function indicator is illuminated.

   d. The front panel decimal indicator shifts accordingly when the instrument ranges up and down as the input signal is varied.

3. Disconnect the DC source and connect the red and black input leads together.

AC VOLTAGE MEASUREMENT

Manual Ranging

1. Depress the RANGE AC 1 and FUNCTION AC switches. Observe that the AC function indicator is illuminated and the instrument indicates 0.000.

2. Adjust the AC source for 1-volt output. Connect the AC source to the instrument red and black input leads. Observe that the instrument indicates the value of the input signal.

3. Depress the RANGE AC 10 switch. Adjust the AC source for 10-volts output.

4. Depress the RANGE AC 100 switch. Adjust the AC source for 100-volts output.

CAUTION

Between 50 Hz and 20 KHz, do not apply more than 750V rms to the input signal connectors. Between 20 KHz and 50 KHz, do not apply more than 500V rms. Between 50 KHz and 100 KHz, do not apply more than 250V rms. Failure to observe this caution may result in damage to the instrument.

5. Depress the RANGE AC 1K switch. Adjust the AC source for 500 VAC rms.

6. Adjust the AC source for 100-volts output. Depress the RANGE AC 100 switch.

7. Adjust the AC source for 10-volts output. Depress the RANGE AC 10 switch.

8. Adjust the AC source for 1-volt output. Depress the RANGE AC 1 switch.

Automatic Ranging

1. Depress the RANGE AUTO switch. Increase the AC source output from 1 to 10 to 100 and then 500 rms volts. While increasing the AC source output, observe that the instrument front panel decimal indicator shifts from X.XXXX to XX.XXX to XXX.XX and then to XXX.X.

2. Decrease the AC source output from 500 rms volts to 100 to 10 and then to 1 volt while observing that the decimal indicator shifts from XXX.X to XXX.XX to XX.XXX and then to X.XXXX.

3. Disconnect the AC source from the instrument. Connect the instrument red and black input leads together.

RESISTANCE MEASUREMENT

CAUTION

To avoid opening the fuse in the ohms converter input circuit, do not apply voltage to the red and black input leads when the FUNCTION KΩ switch is depressed.

Manual Ranging

1. Depress the RANGE KΩ 1 and FUNCTION KΩ switches. Observe that the KΩ function indicator is illuminated.

2. If the front panel numeral indication is not .0000, vary the front panel KΩ ZERO adjustment to obtain .0000.

NOTE

When measuring resistance in the 100-kilohms and higher ranges, ensure that the resistance box is grounded and that the leads between the box and the instrument input leads are kept as short as possible. This precaution reduces the effects of hum pickup which could cause offset or rattling in the instrument.

3. Connect the resistance box terminals to the instrument red and black input leads. Set the box for one-kilohms output.

4. Depress the RANGE KΩ 10 switch. Set the box for 10-kilohms output.

5. Depress the RANGE KΩ 100 switch. Set the box for 100-kilohms output.

6. Depress the RANGE KΩ 1K switch. Set the box for one-megohms output.

7. Depress the RANGE KΩ 10K switch. Set the box for 10-megohms output.

8. Repeat steps 6, 5, and 4, in that order, first setting the resistance box to the indicated value and then depressing the associated RANGE KΩ switch.

9. Set the box for one-kilohms output. Depress the RANGE KΩ 1 switch.

Automatic Ranging

1. Depress the RANGE AUTO switch. Increase the resistance box output from 1 kilohm to 10 kilohms to 100 kilohms to 1 megohm and then to 10-megohms while observing that the front panel decimal indicator shifts from X.XXXX to XX.XXX to XXX.XX to XXXX.X and then to XXXXX.

2. Decrease the resistance box output from 10 megohms to 1 megohm to 100 kilohms to 10 kilohms and then to 1 kilohm while observing that the decimal indicator shifts from XXXXX. to XXXX.X to XX.XXX and then to X.XXXX.

3. Disconnect the resistance box from the instrument. Connect the instrument red and black input leads together.

RATIO MEASUREMENT

NOTE

The Model 6653A will accept only a negative reference voltage. Ensure blue lead is connected to (–) connector and yellow lead is connected to (+) connector.

Manual Ranging

1. Connect the 10-volt battery to the yellow and blue reference input leads with the positive battery terminal to the yellow lead.

2. Depress the RANGE RATIO 10 and FUNCTION DC RATIO switches. Observe that both the V/DC and RATIO function indicators are illuminated and that the front panel numeral indication is .0000.

3. Adjust the DC source for 10-volts output. Connect the source to the red and black signal input leads with the source positive output to the red lead.

4. Observe that the instrument indicates a ratio of approximately +1.0000.

5. Depress the RANGE RATIO 100 switch. Adjust the DC source for 100-volts output. Observe that the instrument indicates a ratio of approximately +10.000.

6. Depress the RANGE RATIO 1K switch. Adjust the DC source for 1000-volts output. Observe that the instrument indicates a ratio of approximately +100.00.

7. Adjust the DC source for 100-volts output. Depress the RANGE RATIO 100 switch. Observe that the instrument indicates a ratio of approximately +10.000.

8. Adjust the DC source for 10-volts output. Depress the RANGE RATIO 10 switch. Observe that the instrument indicates approximately +1.0000.

Automatic Ranging

1. Depress the RANGE AUTO switch.

2. Increase the DC source output from 10 to 100 and then to 1000 volts while observing that the instrument front panel decimal indicator shifts from X.XXXX to XX.XXX and then to XXX.XX.

3. Decrease the DC source output from 1000 to 100 and then to 10 volts while observing that the decimal indicator shifts from XXX.XX to XX.XXX then to X.XXXX.

PRINT OUTPUT

1. Connect the instrument rear panel print output connectors to a printer and depress the PRINT AUTO switch.

2. Vary the DC source output between 10 volts and 1 volt while observing that the printed information is the same as the instrument front panel indication.

3. Depress the PRINT HOLD switch and observe that the printout stops.

4. Vary the DC source output and observe that the instrument front panel indication does not change.

5. Depress the momentary-contact PRINT FORCE switch and observe that there is one printout of the instrument front panel indication.

6. Repeat step 4.

7. Disconnect the DC source, battery, and printer from the instrument. Connect the instrument red and black input leads together.

8. Position the POWER-RATE control to OFF.

REMOTE CONTROL

NOTE

It is recommended that the INTERFACING discussion at the end of Section V be read before proceeding with the remote control checkout.

1. Using the two Amphenol 50-pin connectors, connect the test setup as shown in figure 3-2 if the instrument contains the buffered remote control option or figure 3-3 if the instrument contains the non-buffered remote control option.

2. Depress the FILTER OFF, REMOTE, and PRINT OFF switches and position the RATE control fully clockwise.

3. Remotely program each of the functions in sequence, observing that the corresponding front panel function indicators are illuminated in turn.

4. Program EXT REF SEL and observe that the RATIO function indicator is illuminated.

   a. Program MV and observe that the RATIO and MV/DC function indicators are illuminated. Successively program R2, R3, and R4 and observe that the decimal indication is .XXXXX, X.XXXX, and XX.XXX respectively.

   b. Remove MV and R4 programs. Program AC and observe that the RATIO and AC function indicators are enabled. Successively program R2, R3, and R4 and observe that the decimal indication is .XXXXX, X.XXXX, and XX.XXX respectively.

   c. Remove AC and R4 programs. Program KΩ and observe that the RATIO and KΩ function indicators are enabled. Successively program R2, R3, and R4 and observe that the decimal indication is .XXXXX, X.XXXX and XX.XXX respectively.

   d. Remove EXT REF SEL and R4 programs.

5. Program R1 through R5 in sequence observing that the decimal point indicator is properly positioned in each range.

6. Remove R5 program. Program AUTO.

   a. Observe that the decimal indication is .XXXXX.

   b. Disconnect the red and black INPUT leads from each other and observe that the decimal indication shifts from .XXXXX to XXXXX. in one-digit steps.

7. Remove AUTO program. Program R2 and connect the red and black INPUT leads together.

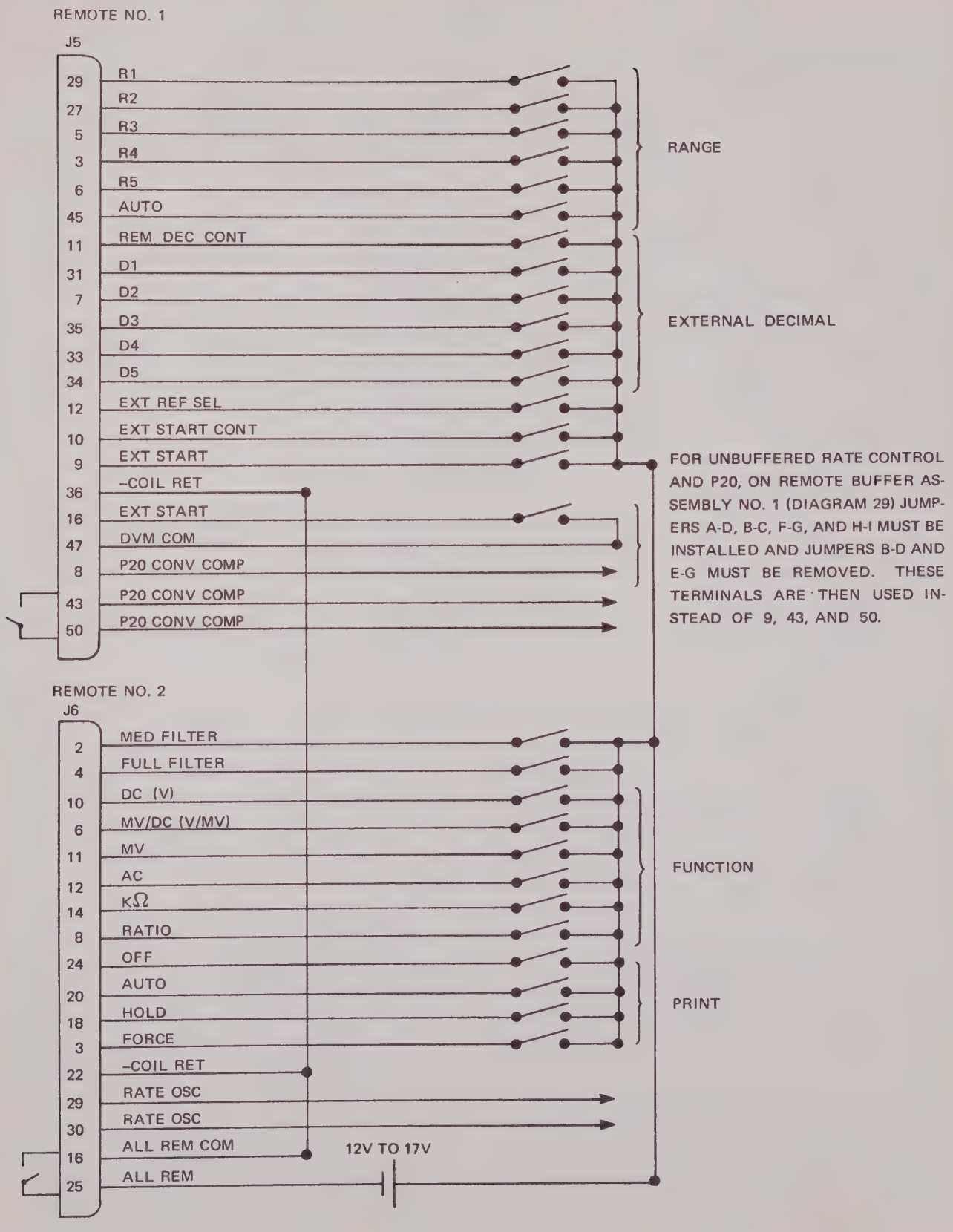


Figure 3-2. Buffered Remote Control Test Setup.

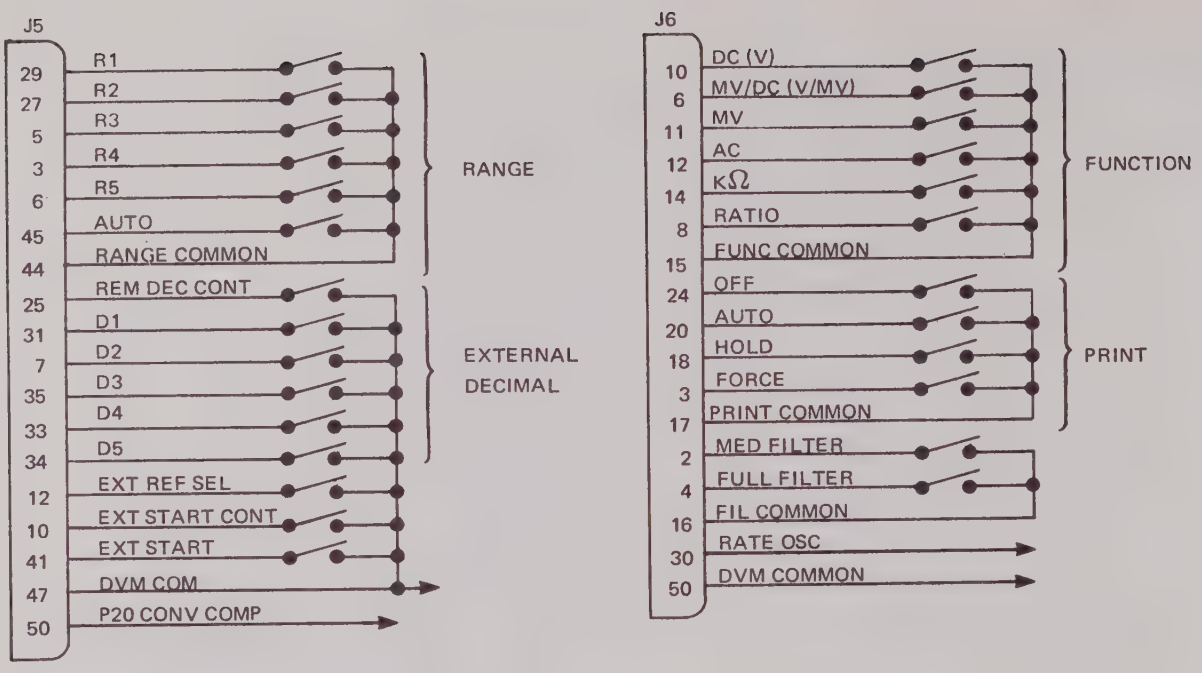


Figure 3-3. Non-buffered Remote Control Test Setup.

a. Connect an oscilloscope to the rate oscillator output and observe that the pulse rate is approximately 5 Hz.

b. Connect the oscilloscope to the P20 output and observe that the conversion rate is approximately 5 Hz.

c. Program EXT START CONT and observe that the conversions stop.

WARNING

To avoid damaging the instrument, the EXT START pulse must never exceed +5 volts in amplitude.

d. Momentarily program and remove EXT START and observe that only one conversion is performed (indicated by only one P20 being generated). In the unbuffered option, a conversion is performed each time the external start is released. In the buffered option, a conversion is performed each time the external start is programmed.

8. Remove EXT START CONT program. With R2 still programmed, program REM DEC CONT and observe that no decimal indicators are illuminated.

9. Program D1 through D5 in sequence and observe that the associated decimal indicators illuminate in turn.

10. Remove REM DEC CONT program command and observe that the R2 decimal indicator illuminates.

11. Depress the front panel REMOTE switch. Program DC V function. Connect the DC source to the red and black INPUT leads. Repeat the PRINT OUTPUT procedure by remotely programming the front panel controls.

12. Position the POWER-RATE control to OFF. Disconnect the DC source and test setup from the instrument. Connect the red and black INPUT leads together.

SECTION IV
CALIBRATION AND VERIFICATION OF SPECIFICATIONS

GENERAL

This section contains procedures for instrument calibration and verifying of electrical specifications. The procedures assume that all optional plug-in accessories are inserted in the instrument. Omit procedural steps applicable to plug-in accessories not in the instrument.

Accuracy of calibration and verification depends on the use of quality test equipment. Test equipment employed should be as good or better than the equipment specified for use in the procedures. For example, if an accurate DC voltage calibrator capable of supplying 1000 volts is not available a lower voltage may be substituted. The accuracy of calibration and verification of specifications will be proportionately less, however, as the supply voltage is decreased.

Prior to calibration or verification, the instrument must be placed in the environment of the work area for sufficient time to allow the internal temperature to stabilize. A stabilizing time of one hour for every 10°C change in temperature is required.

The accuracy of the internal reference supply is within specification in a relatively short time. If ultimate accuracy is to be realized, however, complete stabilization is necessary prior to calibration. When power has been removed from the instrument for an appreciable time, a 30-minute warmup period must be allowed for complete instrument stabilization.

NOTE

Except as indicated, the green INPUT lead should be connected to the black INPUT lead for all calibration and specification verifying procedures.

CALIBRATION PROCEDURES

The following equipment is required to perform the calibration procedures:

1. 5-Digit Digital Voltmeter (DVM), Cimron Model 7630 or equivalent

2. DC Voltage Calibrator, Fluke Model 332A or equivalent

3. Thermal Transfer Standard, Fluke Model 540B, with Model A54-1 Voltage Plug-In Unit or equivalent

4. AC Laboratory Calibration Source, Optimation Model AC104A or equivalent

5. Six resistors:

1 KΩ ±0.005%	100 KΩ ±0.005%
10 KΩ ±0.005%	1 MΩ ±0.01%
50 KΩ ±5%	10 MΩ ±0.025%

6. Oscilloscope, Tektronix Model 502A or equivalent

Remove the top cover. All calibration controls and test points are identified on the top shield (figure 4-1).

BASIC DC INSTRUMENT

To perform the basic DC instrument calibration procedure:

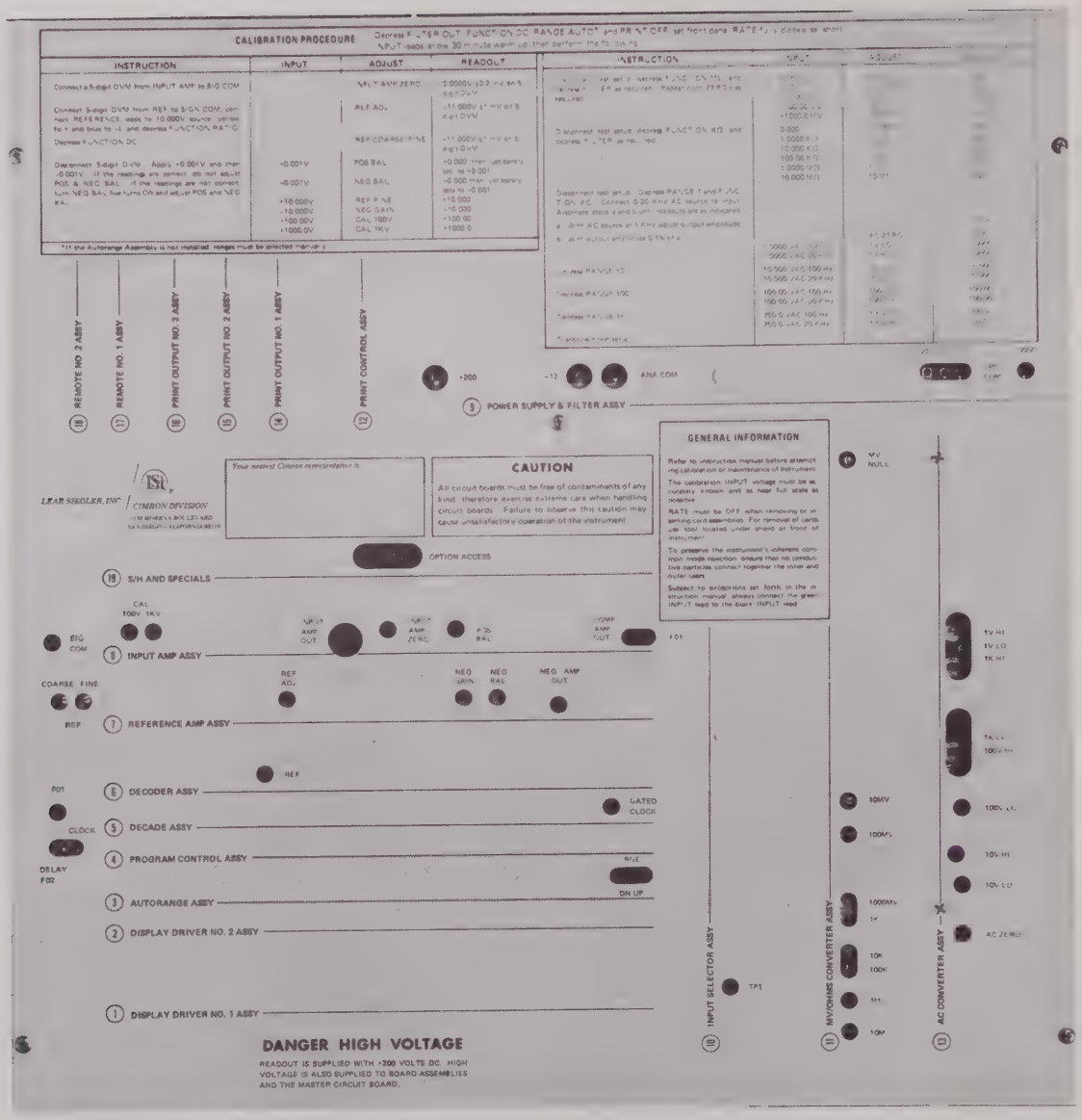

CALIBRATION PROCEDURE
INSTRUCTION
INPUT
ADJUST
READOUT
REMOTE NO. 2 ASSY
REMOTE NO. 1 ASSY
PRINT OUTPUT NO. 3 ASSY
PRINT OUTPUT NO. 2 ASSY
PRINT OUTPUT NO. 1 ASSY
PRINT CONTROL ASSY
POWER SUPPLY & FILTER ASSY
ANA COM
GENERAL INFORMATION
CAUTION
All circuit boards must be free of contaminants of any kind; therefore exercise extreme care when handling circuit boards. Failure to observe this caution may cause unsatisfactory operation of the instrument.
LEAR SIEGLER, INC. / CIMRON DIVISION
OPTION ACCESS
S/H AND SPECIALS
INPUT AMP ASSY
REFERENCE AMP ASSY
DECODER ASSY
DECADE ASSY
PROGRAM CONTROL ASSY
AUTORANGE ASSY
DISPLAY DRIVER NO. 2 ASSY
DISPLAY DRIVER NO. 1 ASSY
INPUT SELECTOR ASSY
MV/OHMS CONVERTER ASSY
AC CONVERTER ASSY
DANGER HIGH VOLTAGE
READOUT IS SUPPLIED WITH +200 VOLTS DC. HIGH VOLTAGE IS ALSO SUPPLIED TO BOARD ASSEMBLIES AND THE MASTER CIRCUIT BOARD.

Figure 4-1. Test Point and Adjustment Control Locations.

1. Disable the Sample and Hold Assembly by removing the top shield, disconnecting the TJ1-TJ2 jumper and reconnecting to TJ2-TJ3. Replace the top shield.

2. Position the front panel controls to the initial setting (table 3-2).

3. Connect the test setup as shown in figure 4-2.

4. Vary the INPUT AMP ZERO adjustment control (figure 4-1) for 0.0000V ±0.2 MV on the 5-digit DVM.

5. Connect the test setup as shown in figure 4-3.

NOTE

The Model 6653A will accept only a negative reference voltage. Ensure blue lead is connected to (–) connector and yellow lead is connected to (+) connector.

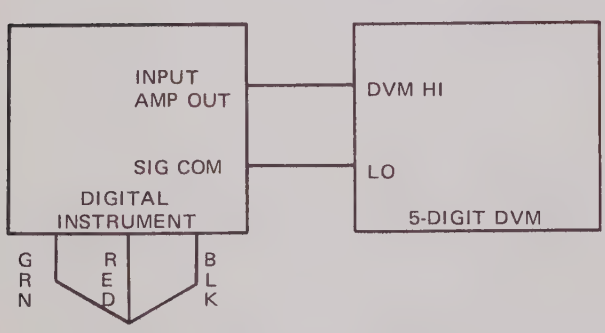


Figure 4-2. Basic DC Instrument Calibration Test Setup No. One.

5. Adjust the voltage calibrator to 10.000 VDC.

6. Depress the FUNCTION DC RATIO switch.

7. Vary the REF ADJ adjustment control (figure 4-1) for –11.000 ±1 MV on the 5-digit DVM.

8. Depress the FUNCTION DC V switch.

9. Vary the REF COARSE and FINE adjustment controls (figure 4-1) for –11.000 ±1 MV on the 5-digit DVM.

10. Disconnect the external 5-digit DVM and remove the blue and yellow REFERENCE leads from the voltage calibrator (figure 4-3).

11. Adjust the voltage calibrator to 0.001 VDC.

12. Observe the front panel for an indication of –0.001. Reverse the INPUT leads (figure 4-3), and observe the front panel for an indication of +0.001. If the front panel indications are correct, proceed to step 20.

13. Turn the NEG BAL adjustment control (figure 4-1) approximately five turns clockwise.

14. Vary the POS BAL adjustment control (figure 4-1) for a front panel indication of +0.000.

15. Slowly turn the POS BAL adjustment control (figure 4-1) counterclockwise until the front panel indication just barely sets to +0.001.

16. Reverse the INPUT leads (red to – and black to +).

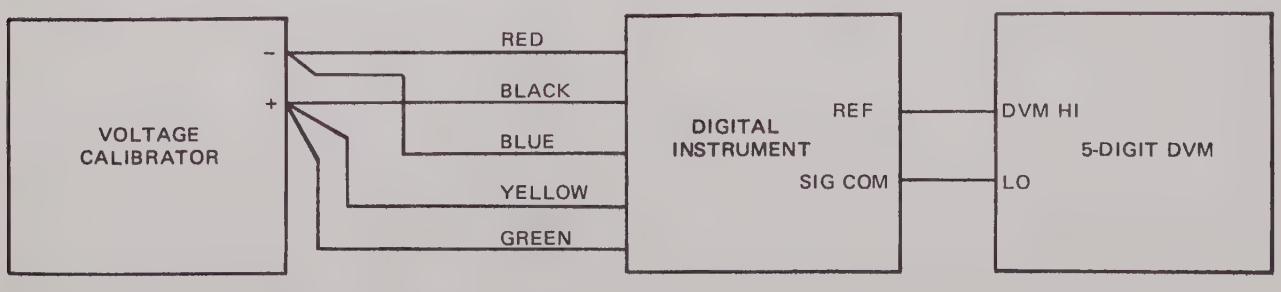


Figure 4-3. Basic DC Instrument Calibration Test Setup No. Two.

17. Vary the NEG BAL adjustment control (figure 4-1) for a front panel indication of –0.000.

18. Slowly turn the NEG BAL adjustment control (figure 4-1) counterclockwise until the front panel indication just barely sets to –0.001.

19. Reverse the INPUT leads.

20. Adjust the voltage calibrator to 10.000 VDC.

21. Vary the REF FINE adjustment control (figure 4-1) for a front panel indication of +10.000.

22. Reverse the INPUT leads.

23. Vary the NEG GAIN adjustment control (figure 4-1) for a front panel indication of –10.000.

24. Reverse the INPUT leads.

25. Adjust the voltage calibrator to 100.00 VDC.

26. Vary the 100V CAL adjustment control (figure 4-1) for a front panel indication of +100.00.

27. Adjust the voltage calibrator to 1000.0 VDC.

28. Vary the 1000V CAL adjustment control (figure 4-1) for a front panel indication of +1000.0.

29. Adjust the voltage calibrator to 10 VDC and disconnect the test setup.

MV/OHMS CONVERTER PLUG-IN ACCESSORY

To perform the MV/Ohms Converter calibration procedure:

1. Depress the FILTER MED and FUNCTION DC MV switches and position the other front panel controls to the initial setting (table 3-2).

2. Set the front panel MV ZERO adjustment control to the middle of its range by counting the turns.

3. Connect a 50 KΩ resistor between the red and black INPUT leads.

4. Vary the MV NULL adjustment control (figure 4-1) for a front panel indication of +0.000.

5. Remove the 50 KΩ resistor from the INPUT leads and connect them together.

6. Vary the front panel MV ZERO adjustment control for a front panel indication of 0.000.

7. Repeat steps 3 through 6 until the front panel indication remains at +0.000 under both high input resistance and shorted input conditions.

CAUTION

To avoid opening the fuse in the DC preamplifier input circuit, do not apply more than 125 volts to the red and black input leads when the FUNCTION DC MV switch is depressed.

8. Connect the test setup as shown in figure 4-4.

9. Adjust the voltage calibrator to 10.000 VDC and set the voltage divider to .0010.

10. Vary the 10MV adjustment control (figure 4-1) for a front panel indication of +10.000.

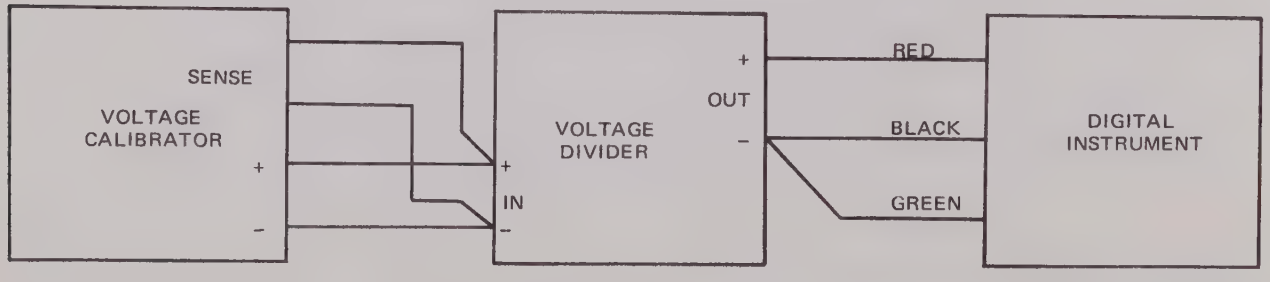


Figure 4-4. Millivolt Calibration Test Setup.

11. Set the voltage divider to .0100.

12. Vary the 100MV adjustment control (figure 4-1) for a front panel indication of +100.00.

13. Set the voltage divider to .1000.

14. Vary the 1000MV adjustment control (figure 4-1) for a front panel indication of +1000.0.

15. Disconnect the test setup.

16. Depress the FUNCTION KΩ switch.

CAUTION

To avoid opening the fuse in the ohms converter input circuit, do not apply voltage to the red and black input leads when the FUNCTION KΩ switch is depressed.

17. Connect the red and black INPUT leads together and vary the front panel KΩ ZERO adjustment control for a front panel indication of .0000, ±1 digit.

18. Connect the 1 KΩ ±0.005% resistor between the red and black INPUT leads. Vary the 1 KΩ adjustment control (figure 4-1) for a front panel indication of 1.0000.

19. Connect the 10 KΩ ±0.005% resistor between the red and black INPUT leads and vary the 10KΩ adjustment control (figure 4-1) for a front panel indication of 10.000.

NOTE

When calibrating the 100-kilohm and higher ranges, care should be taken not to touch any part of the system and, if the external precision resistors are located in a resistance box, ensure that the box is grounded and that the leads between the box and the INPUT leads are kept as short as possible. These precautions reduce the effects of hum pickup which could cause offset or rattling in the instrument.

20. Connect the 100 KΩ ±0.005% resistor between the red and black INPUT leads and vary the 100KΩ adjustment control (figure 4-1) for a front panel indication of 100.00.

21. Connect the 1 MΩ ±0.01% resistor between the red and black INPUT leads and vary the 1MΩ adjustment control (figure 4-1) for a front panel indication of 1000.0.

22. Connect the 10 MΩ ±0.025% resistor between the red and black INPUT leads and vary the 10MΩ adjustment control (figure 4-1) for a front panel indication of 10000..

23. Because of possible interaction, steps 18 through 22 should be rechecked and adjusted if necessary.

AC CONVERTER PLUG-IN ACCESSORY

CAUTION

Between 50 Hz and 20 KHz, do not apply more than 750V rms to the input signal connectors. Between 20 KHz and 50 KHz, do not apply more than 500V rms. Between 50 KHz and 100 KHz, do not apply more than 250V rms. Failure to observe this caution may result in damage to the instrument.

The AC converter is an average-reading converter calibrated to the rms equivalent. To provide an accurate rms calibration voltage:

1. Connect the test setup as shown in figure 4-5.

2. Apply a DC voltage, of the same amplitude as the desired AC rms voltage, to the transfer standard.

3. Vary the transfer standard null controls for a null indication.

4. Apply an AC voltage of the desired frequency to the transfer standard and vary the AC voltage for a null indication. The rms value of the AC voltage is equal in amplitude to the DC voltage.

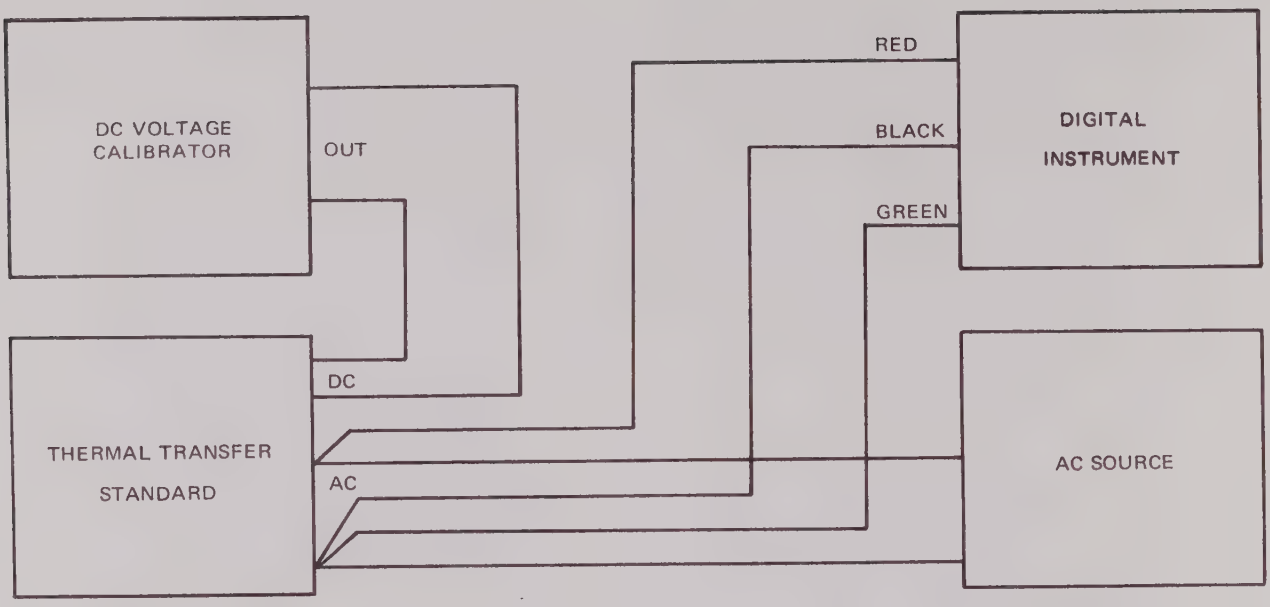


Figure 4-5. AC Converter Calibration Test Setup.

5. Maintain the null while performing the calibration and verification procedures.

To perform the AC Converter calibration procedure:

1. Depress the RANGE AC 1 and FUNCTION AC switches and position the remaining front panel controls to the initial setting (table 3-2).

NOTE

Alternate steps 2 and 3 until the readouts are attained.

2. Adjust the AC source output frequency to 1 KHz and output amplitude for a DMM readout of 1.0000.

3. Adjust the AC source output amplitude to 0.1% of step 2. Vary top shield AC ZERO adjustment control (figure 4-1) for a readout of .0010.

4. Adjust the AC source output to 1.0000V, 100 Hz. Vary the 1V LO adjustment control (figure 4-1) for a readout of 1.0000.

5. Adjust the AC source output to 1.0000V, 20 KHz. Vary the 1V HI adjustment control (figure 4-1) for a readout of 1.0000.

6. Depress the RANGE AC 10 switch. Adjust the AC source output to 10.000V, 100 Hz. Vary the 10V LO adjustment control (figure 4-1) for a readout of 10.000.

7. Adjust the AC source output to 10.000V, 20 KHz. Vary the 10V HI adjustment control (figure 4-1) for a readout of 10.000.

8. Depress the RANGE AC 100 switch. Adjust the AC source output to 100.00V, 100 Hz. Vary the 100V LO adjustment control (figure 4-1) for a readout of 100.00.

9. Adjust the AC source output to 100.00V, 20 KHz. Vary the 100V HI adjustment control (figure 4-1) for a readout of 100.00.

10. Depress the RANGE AC 1K switch. Adjust the AC source output to 750.0V, 100 Hz. Vary the 1KV LO adjustment control (figure 4-1) for a readout of 750.0.

11. Adjust the AC source output to 750.0V, 20 KHz. Vary the 1KV HI adjustment control (figure 4-1) for a readout of 750.0.

12. Adjust the AC source output to zero. Disconnect the test setup.

SAMPLE AND HOLD PLUG-IN ACCESSORY

To perform the Sample and Hold calibration procedure:

1. Remove top shield.

2. On Sample and Hold Assembly remove jumper from TJ2-TJ3 and install between TJ1-TJ2.

3. Connect the red and black input leads together.

4. Adjust DC OFFSET ADJ on the Sample and Hold Assembly for a readout of .0000.

5. If it is desired to disable the Sample and Hold Assembly while verifying the specifications or for normal instrument operation, reconnect the jumper between TJ2-TJ3.

6. Replace the top shield.

VERIFICATION OF SPECIFICATIONS

Prior to verifying the specifications, ensure that the calibration procedures have been performed. If the verification of specifications is performed with the Sample and Hold Assembly installed in the instrument and activated, add ±0.01% to the accuracy specifications.

The following equipment is required to verify the specifications:

1. Voltage Divider, ESI Model RV722 or equivalent

2. AC Laboratory Calibration Source, Optimation Model AC104A or equivalent

3. Two DC Voltage Calibrators, Fluke Model 332A or equivalent

4. Thermal Transfer Standard, Fluke Model 540B with Model A54-1 Voltage Plug-In Unit, or equivalent

5. Audio Voltage Standard, Holt Model 323A or equivalent

6. Ohmmeter, any model

7. Mercury Battery, 1.35V

8. Switch, SPST

9. Six resistors:

100Ω ±5%	100 KΩ ±0.005%
1 KΩ ±0.005%	1 MΩ ±0.01%
10 KΩ ±0.005%	10 MΩ ±0.025%

ACCURACY

DC Measurement

The DC accuracy of the instrument is verified by applying a known DC voltage of each polarity to the input and observing the front panel indication.

To perform the accuracy verification procedure:

1. Position the front panel controls to the initial setting (table 3-2).

2. Connect the test setup as shown in figure 4-6.

3. Adjust the voltage calibrator to 10.000 VDC and observe that the front panel indication is +10.000 ±2 digits.

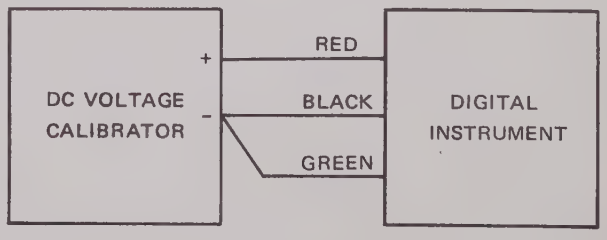


Figure 4-6. DC Measurement Accuracy Test Setup.

4. Adjust the voltage calibrator to 100.00 VDC and observe that the front panel indication is +100.00 ±2 digits.

5. Adjust the voltage calibrator to 1000.0 VDC and observe that the front panel indication is +1000.0 ±2 digits.

6. Adjust the voltage calibrator to 10.000 VDC.

7. Reverse the polarity of the input signal and observe that the front panel indication is −10.000 ±2 digits.

8. Disconnect the test setup.

DC/DC Ratio

In DC/DC voltage ratio measurements, the instrument compares an unknown input signal with a known, external reference voltage and displays the ratio of the input voltage divided by the reference voltage. The external DC reference voltage may vary from −1V to −10V.

To perform the DC/DC ratio accuracy verification procedure:

1. Depress the FUNCTION DC RATIO switch and position the other front panel controls to the initial setting (table 3-2).

2. Connect the test setup as shown in figure 4-7A.

3. Adjust the voltage calibrator to 10.000 VDC output.

4. Adjust the voltage divider setting to 1110. Observe that the front panel indication is −.1110 ±2 digits.

5. Adjust the voltage divider setting to 2220 and observe that the front panel indication is −.2220 ±2 digits.

6. Adjust the voltage divider setting to 4440 and observe that the front panel indication is −.4440 ±2 digits.

7. Adjust the voltage divider setting to 8880 and observe that the front panel indication is −.8880 ±2 digits.

8. Adjust the voltage divider setting to 10000 and observe that the front panel indication is −1.0000 ±2 digits.

9. Connect the test setup as shown in figure 4-7B.

10. Adjust voltage calibrator #1 to 10.000 VDC output.

11. Adjust voltage calibrator #2 to 10.000 VDC output.

12. Repeat steps 4 through 8 except adjust voltage calibrator #1. Observe that the front panel indications are positive (+) polarity.

13. Disconnect the test setup.

AC Measurement

The AC measurement accuracy is verified by applying voltages of known accuracy, at various frequencies, to the red and black leads and observing the DMM front panel readout.

To perform the AC measurement accuracy verification procedure:

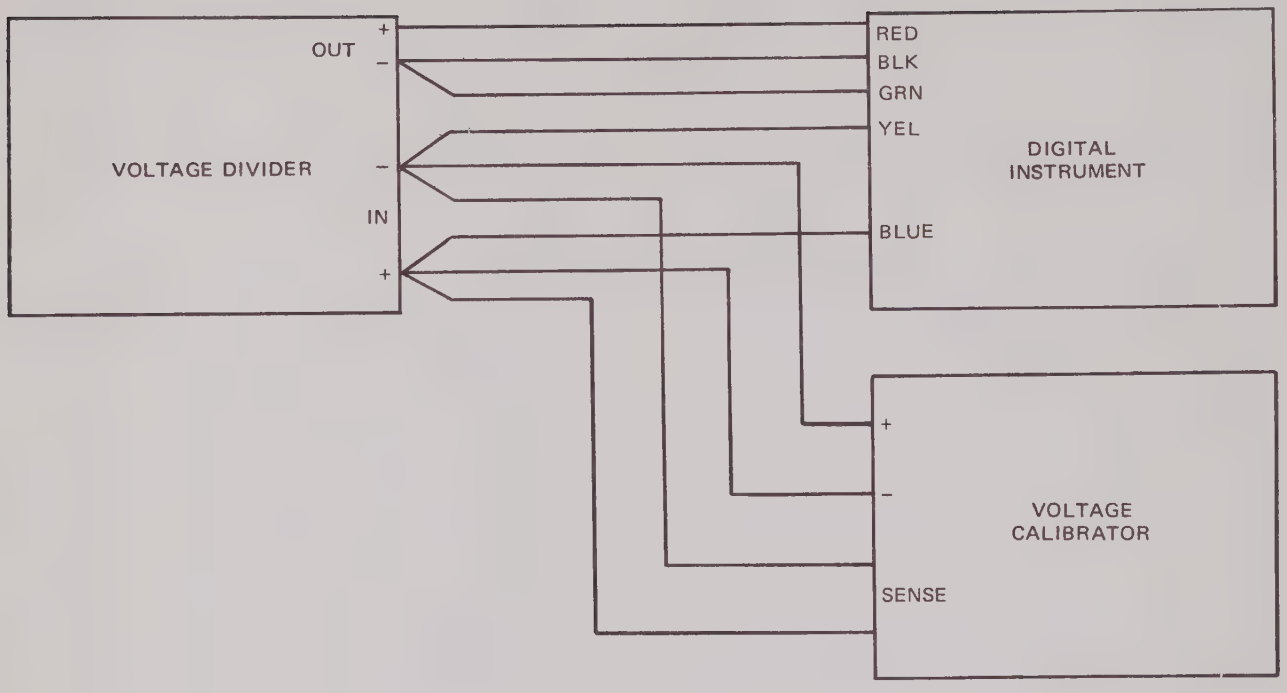
1. Depress the RANGE AC 1 and FUNCTION AC switches and position the other front panel controls to the initial setting (table 3-2).

CAUTION

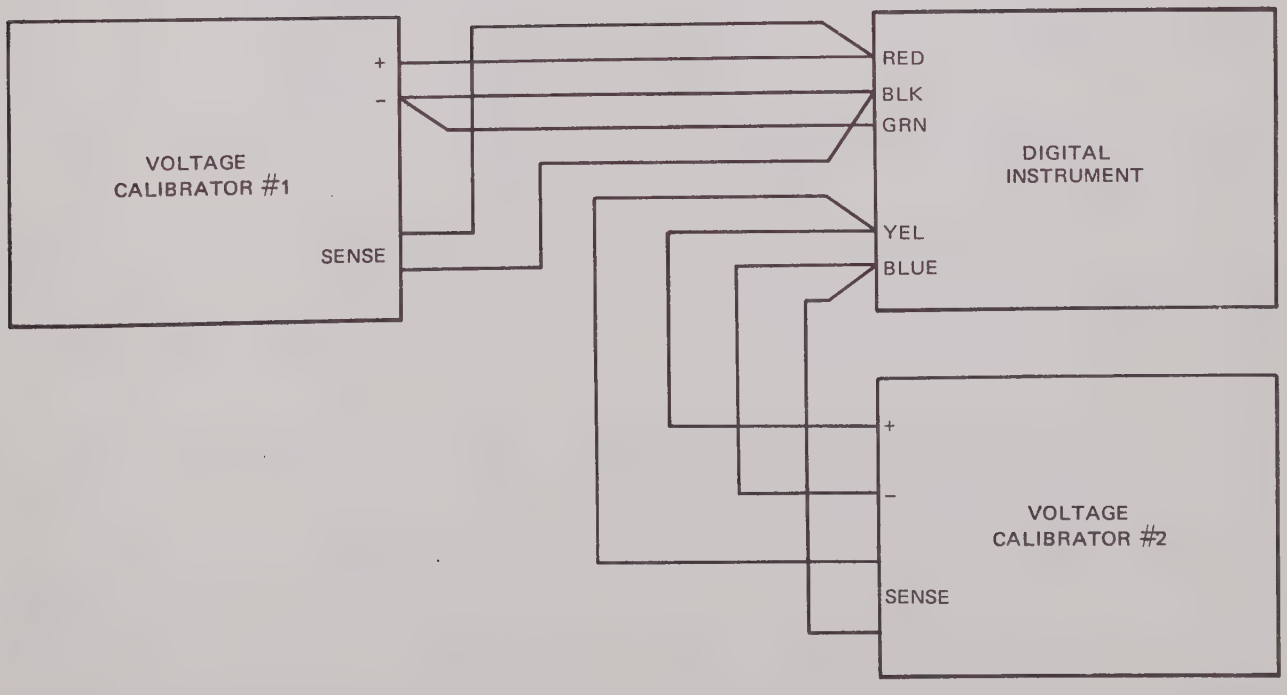
Between 50 Hz and 20 KHz, do not apply more than 750V rms to the input signal connectors. Between 20 KHz and 50 KHz, do not apply more than 500V rms. Between 50 KHz and 100 KHz, do not apply more than 250V rms. Failure to observe this caution may result in damage to the instrument.

2. Connect the test setup as shown in figure 4-5.

3. Using the voltage calibrator and transfer standard, adjust the test setup for an AC source output of 1.0000 VAC. Vary the frequency between 50 Hz and 20 KHz and observe that the DMM front panel readout is 1.0000 ±11 digits.



A. –DC/–DC



B. +DC/–DC

Figure 4-7. Ratio Accuracy Test Setups.

4. Vary the AC source frequency between 20 KHz and 50 KHz and observe that the DMM readout is 1.0000 ±26 digits.

5. Vary the AC source frequency between 50 KHz and 100 KHz and observe that the DMM readout is 1.0000 ±56 digits.

6. Depress the RANGE AC 10 switch. Adjust the test setup for an AC source output of 10.000 VAC. Vary the frequency between 50 Hz and 20 KHz and observe that the DMM readout is 10.000 ±11 digits.

7. Vary the AC source frequency between 20 KHz and 50 KHz and observe that the DMM readout is 10.000 ±26 digits.

8. Vary the AC source frequency between 50 KHz and 100 KHz and observe that the DMM readout is 10.000 ±56 digits.

9. Depress the RANGE AC 100 switch. Adjust the test setup for an AC source output of 100.00 VAC. Vary the frequency between 50 Hz and 20 KHz and observe that the DMM readout is 100.00 ±11 digits.

10. Vary the AC source frequency between 20 KHz and 50 KHz and observe that the DMM readout is 100.00 ±26 digits.

11. Vary the AC source frequency between 50 KHz and 100 KHz and observe that the DMM readout is 100.00 ±56 digits.

12. Depress the RANGE AC 1K switch. Adjust the test setup for an AC source output of 750.0 VAC. Vary the frequency between 50 Hz and 20 KHz and observe that the DMM readout is 750.0 ±9 digits.

13. Adjust the test setup for an AC source output of 500.0 VAC. Vary the AC source frequency between 20 KHz and 50 KHz and observe that the DMM readout is 500.0 ±16 digits.

14. Adjust the test setup for an AC source output of 250.0 VAC. Vary the frequency between 50 KHz and 100 KHz and observe that the DMM readout is 250.0 ±18 digits.

15. Adjust the AC source output to zero. Disconnect the test setup.

Millivolt Measurement

To perform the millivolt measurement accuracy verification procedure:

1. Depress the FILTER MED and FUNCTION DC MV switches and position the other front panel controls to the initial setting (table 3-2).

2. Connect the red and black INPUT leads together and vary the front panel MV ZERO control for a front panel indication of 0.000, ±1 digit.

3. Connect the test setup as shown in figure 4-4.

4. Adjust the voltage calibrator to 10.000 VDC, adjust the voltage divider to .0010, and observe that the front panel indication is +10.000 ±5 digits.

5. Adjust the voltage divider to .0100 and observe that the front panel indication is +100.00 ±3 digits.

6. Adjust the voltage divider to .1000 and observe that the front panel indication is +1000.0 ±3 digits.

7. Reverse the polarity of the input signal and observe that the front panel indication is −1000.0 ±3 digits.

8. Disconnect the test setup.

Resistance Measurement

Resistors used for resistance measurement accuracy verification should have values and tolerances equivalent to the resistors used for MV/Ohms Converter Plug-In Accessory calibration. Refer to the NOTE in the MV/Ohms Converter calibration procedures.

To perform the resistance measurement accuracy verification procedure:

1. Depress the FILTER MED and FUNCTION KΩ switches and position the other front panel controls to the initial setting (table 3-2).

2. Connect the red and black INPUT leads together and vary the front panel KΩ ZERO control for a front panel indication of 0.000, ±1 digit.

3. Connect a 1 KΩ ±0.005% resistor between the red and black INPUT leads and observe that the front panel indication is 1.0000 ±3 digits.

4. Connect a 10 KΩ ±0.005% resistor between the red and black INPUT leads and observe that the front panel indication is 10.000 ±3 digits.

5. Connect a 100 KΩ ±0.005% resistor between the red and black INPUT leads and observe that the front panel indication is 100.00 ±3 digits.

6. Connect a 1 MΩ ±0.01% resistor between the red and black INPUT leads and observe that the front panel indication is 1000.0 ±5 digits.

7. Connect a 10 MΩ ±0.025% resistor between the red and black INPUT leads and observe that the front panel indication is 10000., ±11 digits.

DC RESOLUTION AND SENSITIVITY

To perform the resolution and sensitivity verification procedure:

1. Position the front panel controls to the initial setting (table 3-2).

2. Connect the test setup as shown in figure 4-6.

3. Adjust the voltage calibrator to +5.005 VDC.

4. Increase the voltage calibrator setting in 1-millivolt steps and observe that the front panel indication increases one digit for each 1-millivolt step.

5. Decrease the voltage calibrator setting in 1-millivolt steps and observe that the front panel indication decreases one digit for each 1-millivolt step.

INPUT RESISTANCE

Input resistance verification is accomplished by determining the input current and calculating the resistance. The input resistance is expressed in ohms, with reference to figure 4-8, using the following formulas:

$$\text{Input Current} = \frac{\text{Decrease in Front Panel Indication When S1 is Opened}}{\text{Series Resistance}}$$

$$\text{Input Resistance} = \frac{\text{Front Panel Indication with S1 Open}}{\text{Input Current}}$$

NOTE

Input shielding may be necessary in a noisy environment.

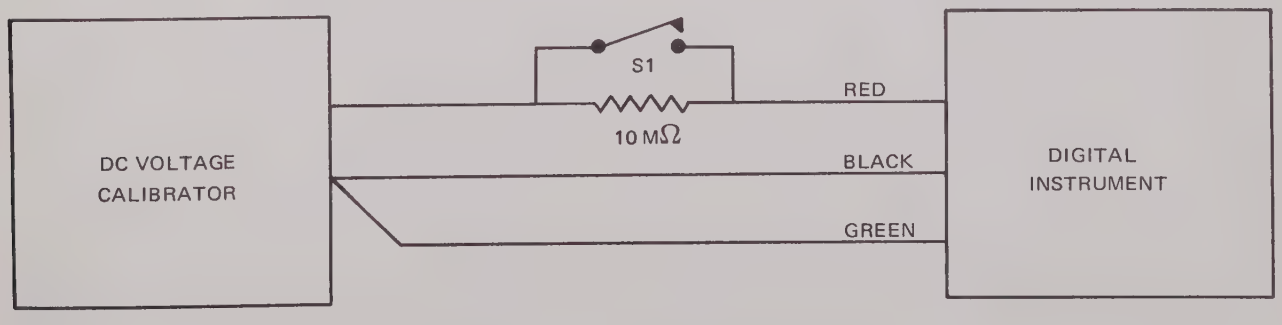


Figure 4-8. Input Resistance Test Setup.

DC Signal Input Resistance

To perform the DC signal input resistance verification procedure:

1. Depress the FILTER FULL switch and position the other front panel controls to the initial setting (table 3-2).

2. Connect the test setup as shown in figure 4-8.

3. Close S1 and adjust the test setup for a front panel indication of 10.010.

4. Open S1 and observe that the front panel indication decreases by less than 0.010V.

5. A decrease of less than 0.010V represents an input resistance in excess of 10,000 megohms.

6. Disconnect the test setup.

AC Signal Input Resistance

To perform the AC signal input resistance verification procedure:

1. Depress the FUNCTION AC switch and position the other front panel controls to the initial setting (table 3-2).

2. Connect the test setup as shown in figure 4-5, with a 1 KΩ resistor in series with the digital instrument red INPUT lead.

3. Adjust the test setup for an AC source output of 10.010 VAC, 100 Hz, and observe that the front panel indication is less than the applied voltage by no more than 0.010V. A decrease of 0.010V represents an input resistance of 1 megohm.

4. Disconnect the test setup.

COMMON MODE REJECTION

The following procedure is used for both AC and DC common mode rejection verification. The AC common mode voltage source is 60 Hz from an audio standard. The DC common mode voltage source is a DC voltage calibrator. If the common mode voltage is E_{cm} and the least significant digit change of the front panel indication is defined as the error voltage E_e, the common mode voltage rejection ratio is expressed in decibels by the following formula:

$$\text{Common Mode Rejection} = 20 \log \frac{E_{cm}}{E_e}$$

To perform the common mode rejection verification procedure:

1. Turn the POWER-RATE switch to OFF, depress the FILTER FULL pushbutton, and position the other front panel controls to the initial setting (table 3-2).

2. Measure the resistance between signal low (black INPUT lead) and the power line ground terminal on the front panel (⏚). The measurement must indicate infinity. Correct any short or leakage before proceeding with the test.

3. Turn the POWER-RATE switch clockwise to approximately half-scale.

4. Connect the test setup as shown in figure 4-9 with the DC common mode source. Adjust the output of the common mode source to zero volt.

5. Adjust the voltage divider for a front panel indication of 1.005.

6. Adjust the output of the common mode source to 1000 VDC.

7. Observe that the front panel indication is 1.005 ±1 digit, indicating a common mode rejection of 120 dB.

8. Disconnect the DC common mode source from the test setup and depress the FILTER OFF pushbutton.

9. Adjust the output of the AC common mode source to zero volt and connect it to the test setup.

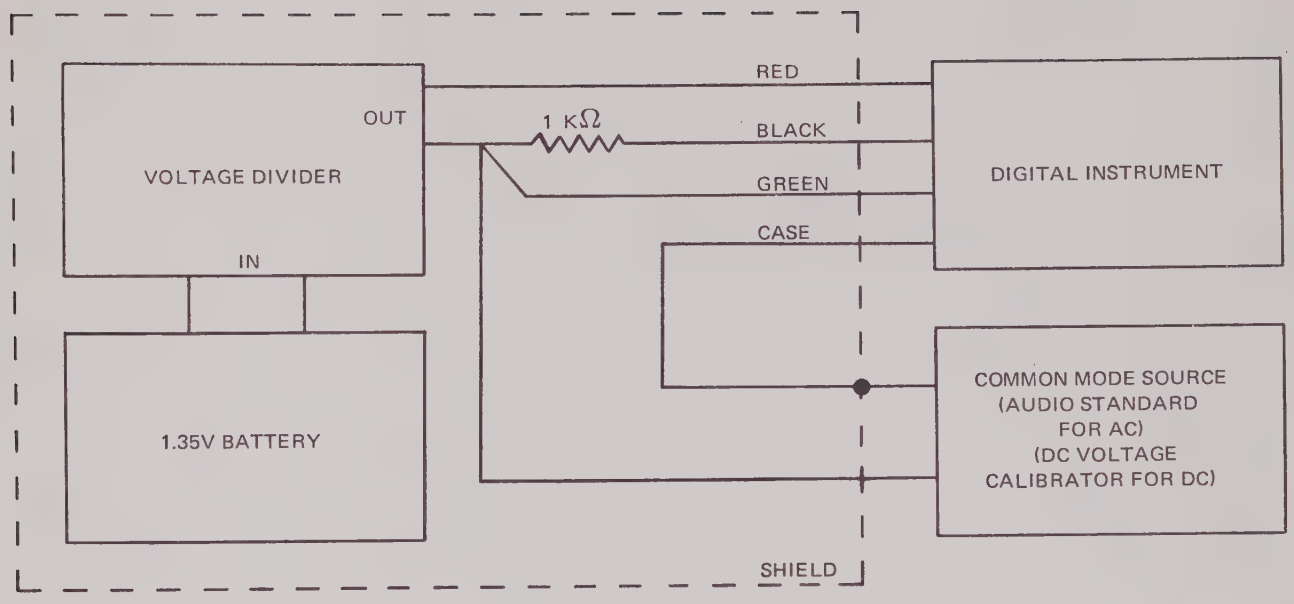


Figure 4-9. Common Mode Rejection Test Setup.

10. Adjust the voltage divider for a front panel indication of 1.005.

11. Adjust the output of the common mode source to 100 VAC peak (70.7 VAC rms), 60 Hz.

12. Observe that repetitive front panel indications do not differ by more than 2 digits, indicating a common mode rejection of 100 dB.

13. Disconnect the test setup.

NORMAL MODE REJECTION

If the normal mode voltage is E_{nm} and the least significant digit change of the front panel indication is defined as the error voltage E_e, the normal mode voltage rejection ratio is expressed in decibels by the following formula:

$$\text{Normal Mode Rejection} = 20 \log \frac{E_{nm}}{E_e}$$

To perform the normal mode rejection verification procedure:

1. Depress the FILTER FULL switch and position the other front panel controls to the initial setting (table 3-2).

2. Adjust the output of the audio standard to zero volt.

3. Connect the test setup as shown in figure 4-10.

4. Adjust the voltage divider for a front panel indication of 1.005.

5. Adjust the output of the audio standard to 1.6 VAC peak (1.314 VAC rms), 60 Hz.

6. Adjust the voltage divider slightly to stabilize the front panel indication and observe that the front panel indication is stable at 1.005, ±1 digit, indicating a normal mode rejection of 70 dB.

7. Adjust the output of the audio standard to zero volt.

8. Depress the FILTER MED switch.

9. Adjust the voltage divider for a front panel indication of 1.005.

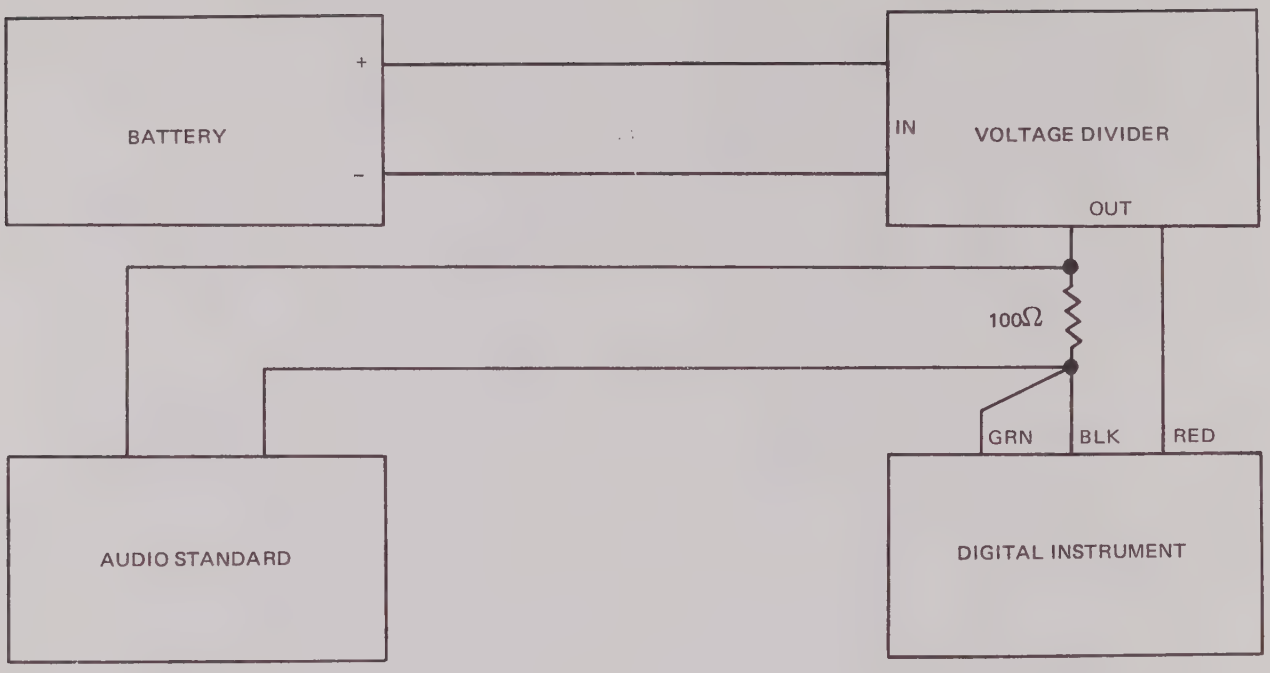


Figure 4-10. Normal Mode Rejection Test Setup.

10. Adjust the output of the audio standard to 0.020 VAC peak (0.0141 VAC rms), 60 Hz.

11. Adjust the voltage divider slightly to stabilize the front panel indication and observe that the front panel indication is stable at 1.005 ±1 digit, indicating a normal mode rejection of 32 dB.

12. Disconnect the test setup. Position the POWER-RATE switch to OFF.

SECTION V

THEORY OF OPERATION

GENERAL DESCRIPTION

The basic Model 6653A is a single-pass, successive-approximation type digital voltmeter. It measures DC voltages from –1099.9 volts to +1099.9 volts in steps of 1 millivolt. It also measures voltage ratios by comparing input voltage of from –1000.0 to +1000.0 against the external reference which may be from –1 volt to –10 volts.

With the accessories installed, the instrument can:

1. Measure AC, millivolt, or resistance input signals.
2. Autorange in all functions.
3. Provide a print output, either 10-line or BCD, capable of driving an external printer or other data processing equipment.
4. Be controlled remotely by voltage state signals or contact closures.
5. Allow the instant storage of an analog value when a start pulse is received.

The theory of operation has been written with the assumption that all optional equipment is installed in the instrument.

In the following description the inputs and outputs of logic gates, flip-flops, inverters, and terminals will be referred to as "high" when in a true or positive state and as "low" when in a false or negative state, unless otherwise specified.

BASIC SUCCESSIVE APPROXIMATION THEORY

Figure 5-1 is a basic block diagram of a one-digit, successive-approximation digital voltmeter capable of measuring 0 to 10 volts in one-volt steps.

A +5-volt input is applied through the input amplifier and R1, causing +5 milliamperes to flow in the summing junction.

When the program control is started, it causes the decade to set the first decoder switch which applies –8 milliamperes to the summing junction. The –8 milliamperes, when summed with the +5 milliamperes from the input, produces a –3 milliamperes difference which causes the error amplifier to produce an output. The error amplifier has an output only when its input is negative. The output from the error amplifier resets the decade, and in turn the decoder, removing the –8 milliamperes from the summing junction.

The program control next causes the decade to set the second decoder switch which applies –4 milliamperes to the summing junction. The junction sum is now +1 milliamperes so the error amplifier does not have an output and the second decoder switch remains set.

The logic then sets the third decoder switch which applies –2 milliamperes to the summing junction. This –2 milliamperes when added to the –4 milliamperes from the second switch is again greater than the +5 milliamperes input and the error amplifier has an output which resets the third decoder switch. The second decoder switch is held in a set condition by the instrument logic.

The fourth decoder switch is then set, adding –1 milliampere to the –4 milliamperes from the second decoder switch and giving a total of –5 milliamperes from the decoder. The sum of the decoder and input currents is now zero. The error amplifier does not have an output and the fourth switch remains set. This completes the program for a one digit instrument.

The information that the second and fourth switches remained set is decoded and applied to the display. The

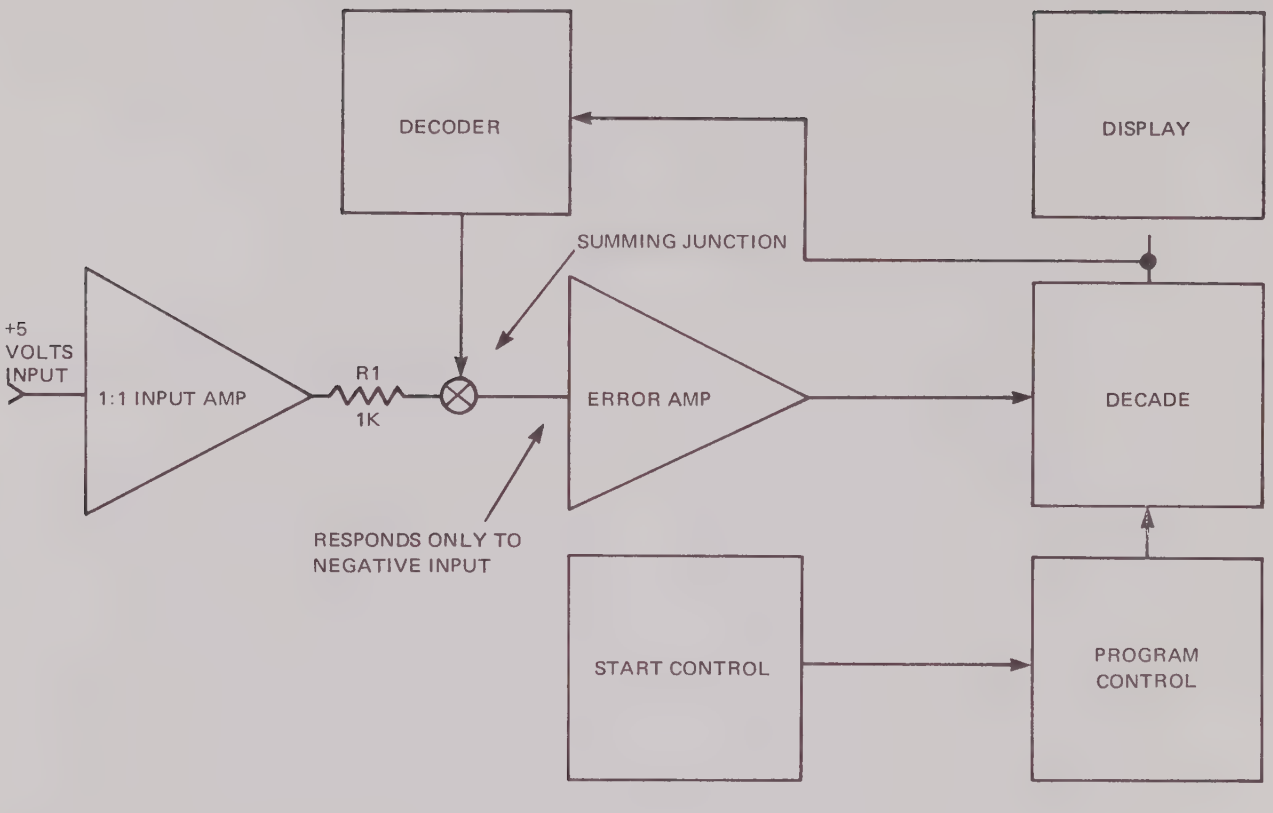


Figure 5-1. One-Digit, Successive Approximation DVM Basic Block Diagram.

display indicates +5 and retains the readout until another cycle is initiated by the start control.

The foregoing theory of operation applies to the Model 6653A except that there are four digits involved (five in overrange) and many associated circuits.

BLOCK DIAGRAM DESCRIPTION

Figure 5-2 is a simplified block diagram of the Model 6653A showing the interrelation of assemblies. The power supply is not shown and many of the control paths have been eliminated and some of the blocks expanded for clarity. For an explanation of the front panel controls, refer to table 3-1.

The Input Selector Assembly controls the routing of the input signal. In DC V or RATIO function, the input is routed directly to the Input Amplifier Subassembly. When the MV, AC, or KΩ function is selected, the input is routed via the appropriate converter to the Input Amplifier Subassembly.

The Input Amplifier Subassembly is comprised of a Ranging Amplifier, summing junction, and Comparator.

The Ranging Amplifier:

1. Provides a high input impedance.
2. Attenuates the input signal by a factor of 1, 10, or 100, dependent upon the range selected.
3. Filters the input signal.
4. Contains a unity-gain, potentiometric amplifier which drives R21, producing a current in the error summing junction which is proportional to the input signal.
5. Provides input to the Negative Amplifier.

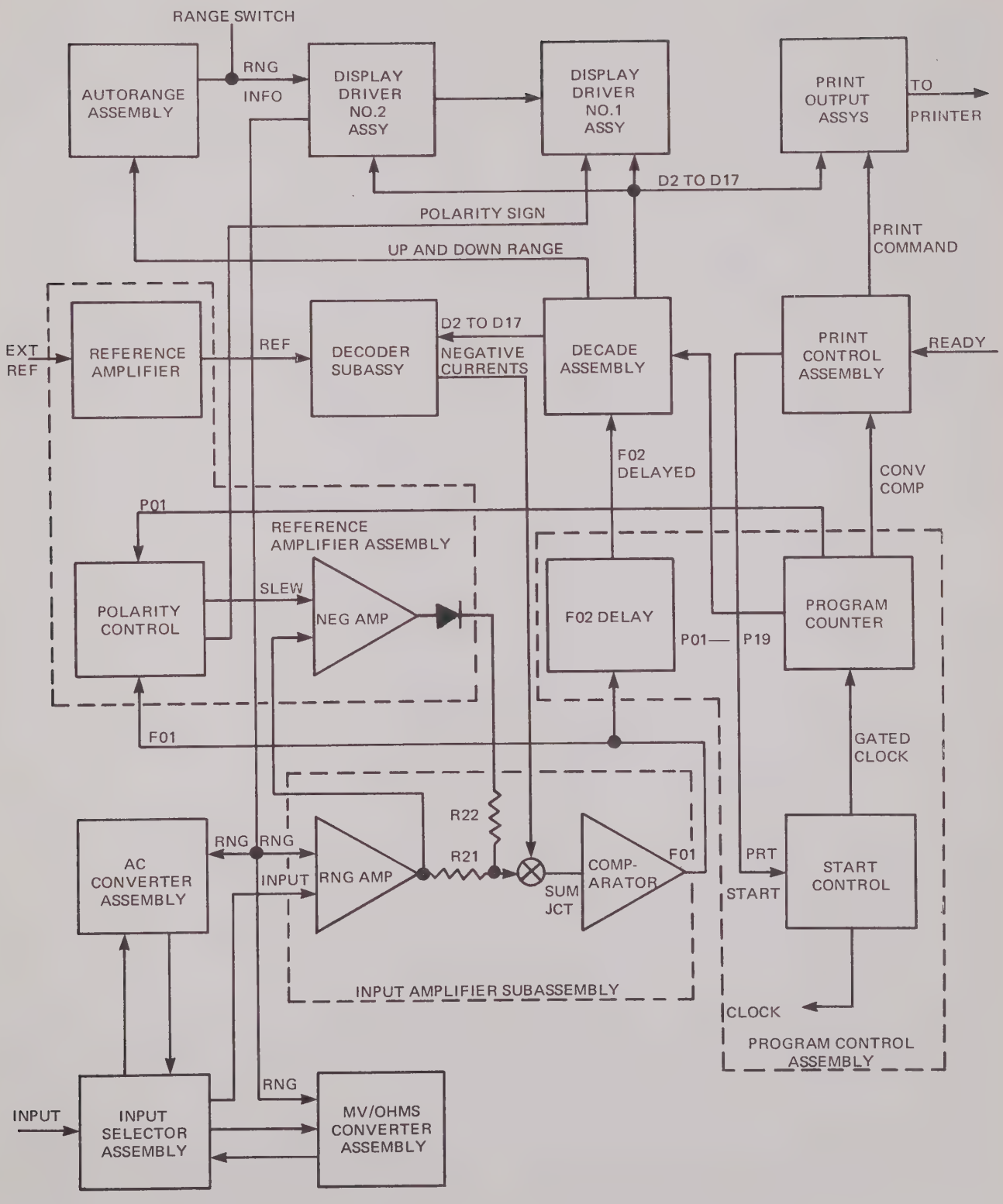


Figure 5-2. Model 6653A Block Diagram.

The Negative Amplifier, located on the Reference Amplifier Assembly, is a unity-gain, inverting, integrated-circuit device. It has a diode in its output to provide a high output signal only when the input is low. The value of R22 is one-half the value of R21, so when the input to the instrument is negative, the Negative Amplifier furnishes twice the current to the error summing junction as does the Ranging Amplifier. The sum of the two input currents produces a positive current proportional to the input voltage. A positive current is necessary because the Decoder Subassembly produces only negative currents to the error summing junction to oppose the input current.

The Comparator produces an output (F01) any time the error summing junction goes negative. The output of the Comparator is applied to the Polarity Control on the Reference Amplifier Assembly and through the Program Control Assembly to the Decade Assembly.

The Program Control Assembly is comprised of the Start Control, Program Control, and F02 Delay.

The Start Control initiates the digitizing of the input signal, provides gated clock pulses to the Program Counter, and provides clock pulses to synchronize the digital operations throughout the instrument. Except when in a print mode, the Start Control also establishes the number of conversions per second that the instrument performs. When the instrument is in a print mode, the Print Control Assembly provides start pulses to the Start Control.

The Program Counter utilizes the gated clock pulses to produce 19 low program pulses, in sequence, which are one clock-period wide. These 19 program pulses are applied via individual signal paths to the Decade Assembly. After the 19th program pulse, a conversion complete signal is provided to the Print Control Assembly.

The F02 delay circuit is activated by the F01 signal from the Comparator. After a 4-microsecond delay for synchronization, the F02 delayed signal is provided to the Decade Assembly.

The first program pulse (P01) resets the Decade Assembly outputs D2 through D17 for a zero output from the Decoder Subassembly. During P01, the Polarity Control sets to the high state and slews the Negative Amplifier to cutoff. With the Decoder Subassembly output at zero and the Negative Amplifier cutoff, only the input signal through R21 is applied to the summing junction. If the input signal is negative in polarity, the Comparator F01 signal resets the Polarity Control to the low state. If the input signal is positive, the Comparator has no output and the Polarity Control remains in the high state. The Polarity Control also controls the front panel polarity display through the Display Driver No. 1 Assembly. At the second program pulse, the Polarity Control removes the slew voltage from the Negative Amplifier. Program pulses 3 through 18 set D2 through D17 in sequence. Each Decade Assembly output remains set unless the Comparator produces an F01 signal during the program pulse. The F01 signal causes an F02 delayed signal, which appears after the program pulse and resets the applicable Decade Assembly output. The D2 through D17 outputs are also applied to the Display Driver Assemblies to drive the front panel indication and to the Print Output Assemblies to enable printout. The Decade Assembly also decodes its own output to provide up and down range commands to the Autorange Assembly.

The Reference Amplifier portion of the Reference Amplifier Assembly utilizes a precision zener reference to produce a stable −11.000 volt output to the Decoder Subassembly except when the instrument is operated in the RATIO function. When in the RATIO function, an external reference voltage of −10 to −1 volts must be provided. The Reference Amplifier output is then the external reference amplified by a factor of 1.1.

The Decoder Subassembly utilizes the drive pulses from the Decade Assembly to switch the reference voltage from the Reference Amplifier through precision resistors which in turn supply a measured amount of negative current to the error summing junction. The negative current from the Decoder Subassembly is summed with the positive current from the input signal and the resultant controls the operation of the Comparator.

The Display Driver Assemblies receive the D2 through D17 drive pulses from the Decade Assembly. The drive pulses are decoded and applied to the front panel display for readout.

The Print Output Assemblies utilize the D2 through D17 drive pulses to provide an output to the external printer. The printer records the information when a print command signal is received from the Print Control Assembly.

The RANGE switch is utilized to select the appropriate range for a given function and input signal. If the RANGE AUTO switch is depressed, the Autorange Assembly selects the appropriate range. The Autorange Assembly up ranges and down ranges upon receipt of command pulses from the Decade Assembly. The range information is decoded by the Display Driver No. 2 Assembly and provided to the Ranging Amplifier, AC Converter Assembly, and MV/Ohms Converter Assembly.

The Print Control Assembly, when activated, controls the sequence of operation. When a print mode is selected and a ready signal is received from the printer, the Print Control Assembly initiates a print cycle. First a settling period is started to allow the instrument and converters to stabilize to the input signal. At the end of the settling period, the Print Control Assembly provides a start pulse to command the instrument to take a reading. When this reading is complete and the information is available at the Print Output Assemblies, the Print Control Assembly issues a print command to the printer. The Print Control Assembly then disables the instrument until the printer completes printing and issues a new ready signal. If the instrument is in the AUTO PRINT mode, the ready signal starts another cycle. In the HOLD PRINT mode, the FORCE PRINT pushbutton must be depressed to start another cycle.

The Remote No. 1 and No. 2, and Remote Buffer No. 1 and No. 2 Assemblies (not shown in figure 5-2) enable remote control of the conversion rate, reference selection, decimal point indication, RANGE, PRINT, FILTER, and FUNCTION switches. When the front panel REMOTE switch is depressed, front panel control of these functions is disabled.

The Sample and Hold Assembly (not shown in figure 5-2) is normally placed electrically between the output of the Ranging Amplifier (figure 5-2) and R21. For the shortest settling time the Sample and Hold Assembly may be electrically placed between the Input Selector Amplifier and the Ranging Amplifier.

ASSEMBLY FUNCTIONAL DESCRIPTIONS

POWER SUPPLY AND FILTER ASSEMBLY (Diagram 1)

The distribution of the Power Supply and Filter Assembly DC voltages are listed in table 5-1.

Table 5-1. Power Supply and Filter Assembly Outputs.

DESTINATION	+4V	+5V	+22V	−22V	+200V	−12V	COMMONS ANA	COMMONS DIG
Input Selector Assembly		x	x	x		x	x	x
MV/Ohms Converter Assembly		x	x	x		x	x	x
AC Converter Assembly		x	x	x			x	x
Input Amplifier Subassembly		x	x	x			x	x
Reference Amplifier Assembly	x	x	x	x			x	x
Decoder Subassembly		x	x	x			x	x
Decade Assembly		x						x
Program Control Assembly		x	x					x
Autorange Assembly		x						x
Display Driver No. 1 Assembly		x			x	x		x
Display Driver No. 2 Assembly		x						x
Print Control Assembly		x	x			x		x
Print Output No. 1 Assembly		x	x			x		x
Print Output No. 2 Assembly		x				x		x
Print Output No. 3 Assembly		x				x		x
Remote No. 1 Assembly		x				x		x
Remote No. 2 Assembly		x				x		x
Sample and Hold Assembly	x	x	x	x				x

The AC inputs to the Power Supply and Filter Assembly are taken from the secondary windings of power transformer T1 on the Master Assembly.

The +22 volt supply receives AC input at terminals 31 and 33. The AC voltage is rectified by integrated-circuit bridge rectifier CR1. The rectified +22 volts is applied to the regulator control transistors Q1 and Q2 and the collector of passing transistor Q1 of the Master Assembly. Control transistor Q1 acts as a constant current source for Q2 which controls the conduction of passing transistor Q1 through terminal 59. Any change in the +22-volt output is sensed at the load on the Master Assembly and fed back through terminal 69 to one base of Q7. Dual transistor Q7, together with Q3 and Q6 amplify the change and apply it to regulator control transistor Q2. Transistor Q2 changes the conduction of the passing transistor to maintain a constant +22 volts through terminal 79 at the load.

The –22 volt supply operates in a manner similar to the +22 volt supply except that it senses the –22 volts at terminal 77.

The +5 volt supply receives rectified input voltage at terminals 73 and 83 from bridge rectifier CR1 through CR4 on the Master Assembly. The +5-volt input is applied to the regulator control transistors Q4 and Q5 and the collector of passing transistor Q2 of the Master Assembly. Transistors Q4 and Q5 amplify any change in +5-volt output at terminal 85. The output of Q4 and Q5 controls the conduction of passing transistor Q2 through terminal 71. The +5-volt output is also passed through level-shifting diode CR8 to provide a +4-volt output at terminal 75.

The 12 VAC input at terminals 15 and 19 is fullwave-rectified by diodes CR10 through CR13. The –12 VDC output is filtered by capacitors C9 and C10 and applied to terminals 11 and 13.

The 200 VAC input at terminals 1 and 3 is fullwave-rectified by integrated-circuit bridge rectifier CR14. The 200 VDC output through terminals 5 and 7 is filtered by a three-section capacitor C1 and resistor R1 on the Master Assembly.

INPUT SELECTOR ASSEMBLY (Diagram 2)

The Input Selector Assembly routes the input signal directly to the Input Amplifier Subassembly when in DC V or RATIO function, or to the appropriate converter when in KΩ, MV, or AC function. The Input Selector Assembly also routes the converter output to the Input Amplifier Subassembly.

The inputs and outputs of the Input Selector Assembly are listed in table 5-2.

The input signal is received at terminals 51 and 47. When the instrument is operated in DC V or RATIO function, the input signal is connected through deenergized relay K3 to terminals 23 and 27. When terminal 81 is grounded Q2 and Q3 are turned on, energizing relays K2 and K3. The input signal is connected through K2 and K3 to terminals 35 and 39 and applied to the AC Converter Assembly. When terminals 83 or 85 are grounded Q1 and Q3 are turned on, energizing K1, K3, and K4. The input signal is connected through K1 and K3 and deenergized relay K2 to terminals 31 and 33 and applied to the MV/Ohms Converter Assembly.

Table 5-2. Input Selector Assembly Inputs and Outputs.

INPUT(S)	TERMINAL(S)	RECEIVER
$\overline{AC}$, $\overline{MV}$, $\overline{K\Omega}$	81, 85, 83	FUNCTION Switch, or Remote No. 2
IN HI, IN LO	51, 47	Input Signal Leads
MV/Ω CONV OUT	1	MV/Ohms Converter
AC CONV OUT	3	AC Converter
OUTPUT(S)	**TERMINAL(S)**	**DESTINATION ASSEMBLY**
MV/Ω IN LO, MV/Ω IN HI	31, 33	MV/Ohms Converter
AC IN LOW, AC IN HI	39, 35	AC Converter
OUT LOW, OUT HI	23, 27	Input Amplifier

The output of the Converters are received at terminal 1 or 3 and applied to integrated-circuit amplifier A1 through the contacts of K1. Amplifier A1 is utilized as an active filter that has a high filtering characteristic for a small change (ripple) while achieving a low step response time. The filtered signal is applied to Amplifier A2. Amplifier A2 provides a gain of 10 when K4 is deenergized and a gain of 1 when K4 is energized. The output is applied through energized relay K3 to terminal 27. When the instrument is in AC, MV, or KΩ mode, terminal 23 is disconnected by K3 and analog common is utilized as the low side of the converter output.

Amplifier A2 is adjusted for zero output by connecting the A-B jumper to B-C and adjusting R12 ZERO potentiometer for zero output with a zero input. This is a factory adjustment and periodic adjustment is not necessary.

AC CONVERTER (Diagram 3)

The AC Converter Assembly rectifies the AC input voltage and applies it through the Input Selector Assembly to the Input Amplifier Assembly. The output of the AC Converter Assembly is 1.0999V full scale.

The assembly is comprised of an input amplifier and a rectifier-amplifier.

The input signal is received at terminals IN HI and IN LO, from the Input Selector Assembly, and applied to input amplifier A1. Amplifier A1 is a wideband, operational amplifier with a high impedance, field effect transistor (FET) input.

The gain of A1 is about 2.2 in the 1-volt range, 0.22 in the 10-volt range, 0.022 in the 100-volt range, and 0.0022 in the 1000-volt range.

In the 1-volt range the feedback path is through R4, R5, C4, and C5 from the divider R12, R13, and C15. Terminals $\overline{CR2}$, $\overline{CR3}$, and $\overline{CR4}$ are connected to the Display Driver No. 2 Assembly. In the 10-volt range (range 2) relay K1 is energized, in the 100-volt range K2, and in the 1000-volt range K3. Except when in the 10-volt range, the 10-volt feedback network is connected to analog common through normally closed contacts of K1. This arrangement minimizes the distributed capacity effect of the feedback networks.

The output of amplifier A1 is coupled through C18 to the rectifier-amplifier.

The rectifier-amplifier is a unity gain, operational amplifier comprised of transistors Q1 through Q5. The push-pull output of the amplifier is fed back through diodes CR12 and R27, and CR13 and R28 to the amplifier input. The half cycle of feedback at the junction of CR12 and R27 is applied through R40 where it is algebraically summed with the input voltage. The resulting voltage is applied as assembly output voltage through terminal AC OUT to the Input Selector Assembly where it is filtered.

Potentiometers R5, R7, R9, and R11 and variable capacitors C5, C7, C9, and C14, and potentiometer R20 are calibration controls accessible through the top shield. Potentiometers R5, R7, R9, and R11 are the AC LO calibration controls and C5, C7, C9, and C14 the AC HI controls. Potentiometer R20, the AC ZERO ADJ control, is used to adjust the rectifier amplifier to the center of its operating range.

Terminal ACLC provides common to the Display Driver No. 1 Assembly to enable the front panel AC function indicator. The indicator is illuminated when the FUNCTION AC switch is depressed.

MV/OHMS CONVERTER ASSEMBLY (Diagram 4)

The MV/Ohms Converter Assembly:

1. In millivolt measurement function, amplifies the millivolt input signal by 10, 100, or 1000 to provide an 11-volt full scale input to the basic instrument.

2. In resistance measurement function, supplies a precise current through the resistance under measurement to develop a voltage proportional to the value of the resistance. The 11-volt full scale voltage is the input to the basic instrument.

The MV/Ohms Converter Assembly is a chopper-stabilized dual purpose unit which, by switching, utilizes the circuitry as a potentiometric amplifier in the millivolt measurement configuration (figure 5-3) or an operational amplifier in the resistance measurement configuration (figure 5-4).

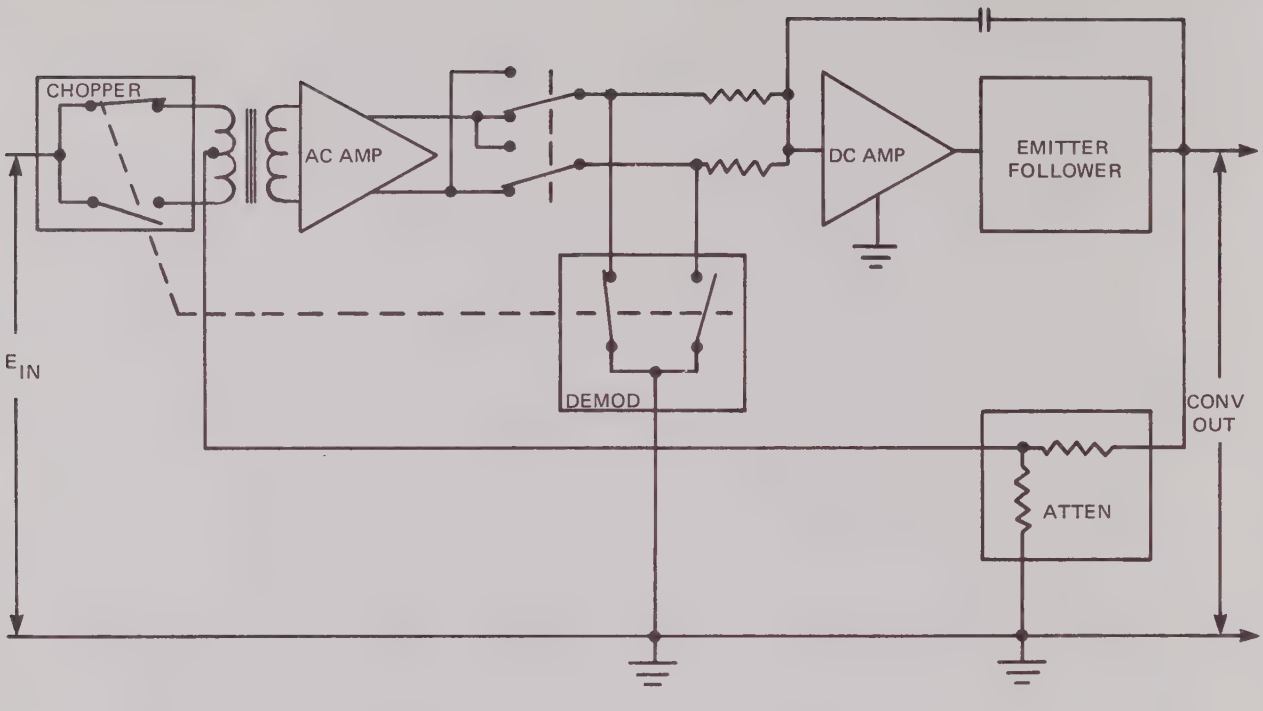


Figure 5-3. Millivolt Measurement Configuration.

The inputs and outputs to the MV/Ohms Converter Assembly are listed in table 5-3.

Table 5-3. MV/Ohms Converter Assembly Inputs and Outputs.

INPUT(S)	TERMINAL(S)	RECEIVED FROM ASSY.
IN HI, IN LO	33, 31	Input Selector
-11	79	Reference Amplifier
$\overline{RG1}$, $\overline{RG2}$, $\overline{RG3}$, $\overline{RG4}$, $\overline{RG5}$	67, 69, 71, 73, 75	Display Driver No. 2
$\overline{K\Omega}$, $\overline{MV}$	83, 85	FUNCTION Switch, or Remote No. 2
OUTPUT	**TERMINAL**	**DESTINATION ASSEMBLY**
CONV OUT	1	Input Selector

Millivolt Measurement

The input to the assembly (diagram 4) is received at terminals 31 and 33. The input is filtered and applied to a chopper comprised of metal oxide semiconductor field effect transistors (MOS FET) Q14 and Q15. The chopper compares the input with the feedback at the centertap of the primary winding of transformer T1. Any difference between the two voltages is amplified by the AC amplifier comprised of Q16 through Q20. The gain of the AC amplifier is approximately 60 dB.

The output from the AC amplifier is routed through function relay K1 and demodulated. Demodulator transistors Q21 and Q22 are in phase with the chopper. The demodulated signal is applied to the input of an integrating amplifier comprised of integrated-circuit amplifier A1,emitter followers Q23 and Q24, and integrating feedback capacitor C8. Potentiometer R67 is the MV NULL adjustment which adjusts the assembly for zero output

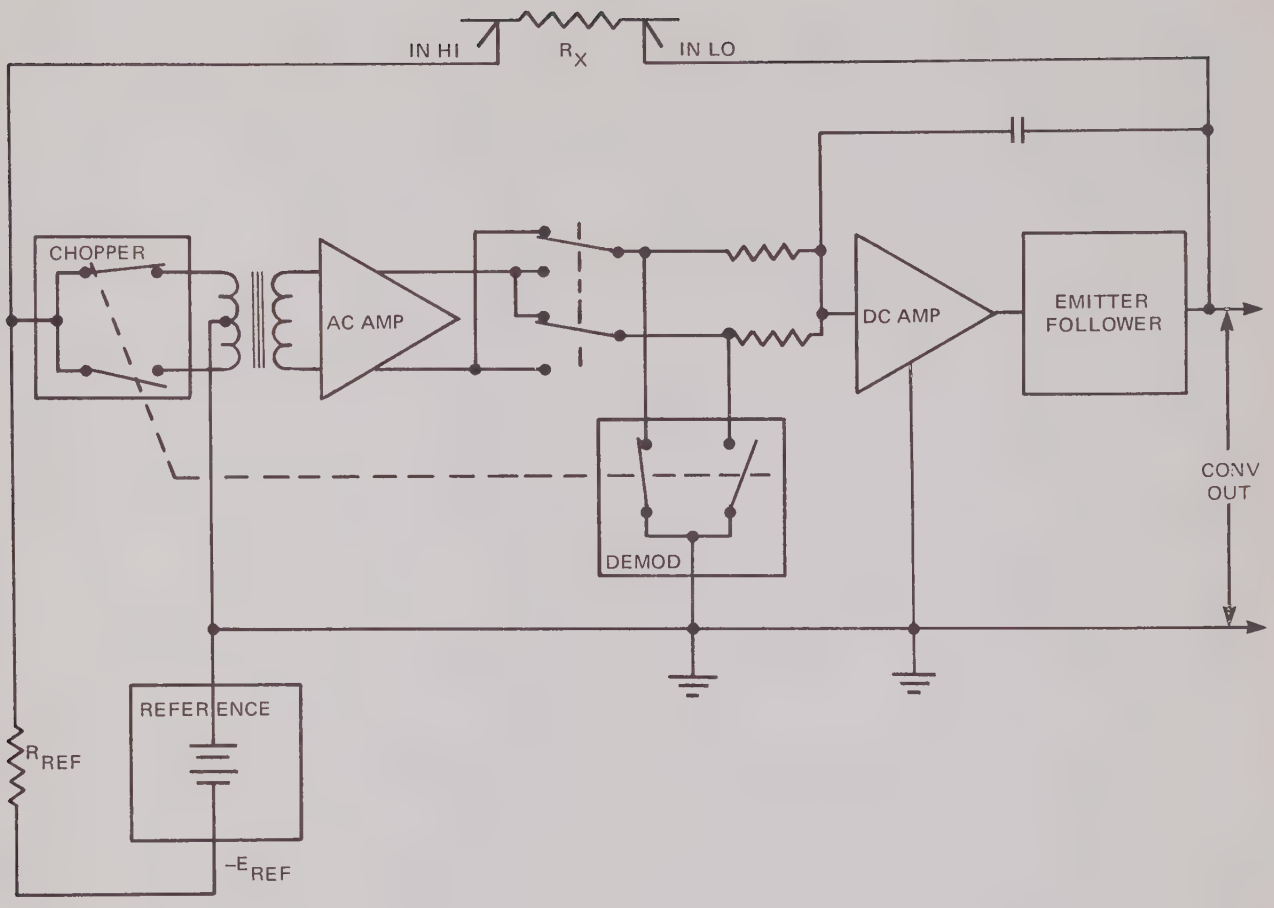


Figure 5-4. Resistance Measurement Configuration.

with zero input under high source impedance conditions. The DC gain of the integrating amplifier is approximately 90 dB. The output of the integrating amplifier is connected to the millivolt feedback attenuator and terminal 17 (KΩ ZERO).

When terminal 85 is grounded, Q9 is turned on and terminals 71 and 73 control range reed relays L7 and L6. In the 10 MV range, R18, R27, and R46 comprise the millivolt feedback attenuator. In the 100 MV range, reed relay L7 adds R17 and R26 in parallel with R18 and R27. In the 1000 MV range, reed relay L6 adds R16, R24, and R25 in parallel with R18 and R27. The output of the millivolt feedback attenuator is applied to the centertap of the primary winding of transformer T1. The overall closed-loop DC gain, as adjusted by potentiometers R27, R26, and R25, is X1000 in the 10 MV range, X100 in the 100 MV range, and X10 in the 1000 MV range. The output of the MV ZERO potentiometer (R2 on the Master Assembly) is also applied through terminal 49 to the centertap of the primary winding of T1. The MV ZERO potentiometer adjusts the assembly for zero output with zero input under shorted input conditions.

Transistor Q11 is normally off and there is no current flowing through the KΩ ZERO potentiometer. The voltage at terminal 1 is therefore the same as the voltage at terminal 17.

The chopper drive signal is generated by a free-running multivibrator comprised of integrated circuit ZA1, R33, C2, R34, and C3. The output from the multivibrator drives transistors Q12 and Q13 which in turn drive the

chopper transistors, Q14 and Q15, and the demodulator transistors, Q21 and Q22.

Terminal 55 (KΩLC) provides DVM common to enable the front panel MV/DC and KΩ function indicators. The indicators are illuminated by the FUNCTION switches through the Display Driver No. 2 Assembly.

Resistance Measurement

When the assembly is switched to resistance measurement by grounding terminal 83, function relay K1 makes three modifications to the circuitry and its operation.

1. The millivolt feedback attenuator is disconnected from the output which leaves the centertap of the transformer primary connected to analog common through R46. The chopper now compares the input signal to analog common instead of a portion of the output.

2. Terminal 31 is disconnected from analog common and connected to the output of the integrating amplifier.

3. The inputs to the demodulator are reversed, changing the phase of the output with respect to the input by 180°.

The grounding of terminal 83 also turns on Q6 enabling terminal 67, 69, 71, 73, or 75 to control range relays L1 through L5. When energized, the reed relays connect reference resistors between the chopper input and the −11-volt reference voltage terminal 79. The reference currents provided for the 1K, 10K, 100K, 1M, and 10M ranges are 10 milliamperes, 1 milliampere, 100 microamperes, 10 microamperes, and 1 microampere respectively, and are adjusted by potentiometers R19 through R23.

When an external resistor is connected between terminal 31 and terminal 33, the operational amplifier is complete. The input resistor is the reference resistor, the input voltage is the −11 volts, and the gain-setting feedback resistor is the external unknown resistor under measurement. The input resistor and input voltage are both fixed. Therefore, the output voltage from the operational amplifier is proportional to the gain which is determined by the external unknown resistor under measurement.

In the 10M, 1M, and 100K ranges, Q11 is off and the voltage at terminal 1 is the same as the output of the operational amplifier. In the 10K and 1K ranges, however, CR6 or CR7 is connected to +5 volts through Q4 and Q5 which turns off Q10 and turns on Q11. Transistor Q11 provides current through the KΩ ZERO potentiometer which produces an offset voltage between terminals 1 and 17. The offset voltage is varied by the KΩ ZERO potentiometer to compensate for up to more than two ohms of external lead resistance. Current provided by Q11 in the 1K range is 10 times greater than the current provided by Q11 in the 10K range. The voltage at terminal 1 is therefore proportional to the value of the external unknown resistance being measured.

INPUT AMPLIFIER SUBASSEMBLY (Diagram 5)

The Input Amplifier Subassembly consists of the input attenuator, input filter, ranging amplifier, summing junction, and comparator. The Input Amplifier Subassembly:

1. Attenuates the input signal voltage to the basic range in DC V or RATIO functions.

2. Provides either medium or full filtering of the input signal. Both filters may also be deenergized to provide no filtering of the input signal.

3. Provides a high input impedance by means of the ranging amplifier.

4. Compares the input voltage with the Decoder Subassembly output and provides logic commands to the Decade Assembly.

The inputs and outputs of the Input Amplifier Subassembly are listed in table 5-4.

The input signal is received at terminal 1. The input attenuator is comprised of resistors R1A through R4 and reed relays L1, L2, and L3. The +4-volt coil drive commands for the 10, 100, and 1000 volt ranges are received at terminals 19, 23, and 21 respectively. The range commands are received through the Reference Amplifier and Display Driver No. 2 Assemblies from the

Table 5-4. Input Amplifier Subassembly Inputs and Outputs.

INPUT(S)	TERMINAL(S)	RECEIVED FROM ASSY.
INPUT	1	Input Selector
-8V, 10V, 100V, 1000V, AMP 2, MED FILTER, FULL FILTER	27, 19, 23, 21, 61, 33, 35	Reference Amplifier
SH OUT	63	Sample and Hold
DECODER INPUT	59	Decoder
OUTPUT	**TERMINAL**	**DESTINATION ASSEMBLY(IES)**
AMP 1	55	Sample and Hold
SH OUT	63	Reference Amplifier
F01	67	Program Control, Reference Amplifier

Autorange Assembly, the front panel RANGE switch, or the Remote No. 1 Assembly. In the 10-volt range, S1 is closed. In the 100-volt range, S2 is closed attenuating the input by a factor of 10 as adjusted by R3 (CAL 100V). In the 1000-volt range, S3 is closed attenuating the input by a factor of 100 as adjusted by R4 (CAL 1KV). The output of the attenuator is 10 volts full scale in all ranges.

The filter is selected by commands through the Reference Amplifier Assembly from the front panel FILTER switch or remotely through the Remote No. 2 Assembly. The medium filter is selected through terminal 33 and energizes L4 closing the contacts of S4 and S5. Some of the AC ripple is shunted to common through passive filter capacitor C1 and the contacts of S4. The remaining ripple is applied to FET Q1 through R5, the contacts of S5, and capacitor C2. Transistor Q1 controls the input to A1, which amplifies and inverts the ripple voltage and applies it back to the input through C4. The out of phase feedback reduces the input ripple to a very low level. When the FILTER FULL switch is depressed L4 and L5 are energized. The ripple voltage is now filtered by passive filters C1 and C5 and active filter A1. Diode CR26 disables the active portion of the full filter from the circuit when in the 1000V range. Zener diodes CR22 and CR23 drop the +22 volts and -22 volts to the proper operating potential for A1 and A2. Figure 5-5 shows the instrument filter response with medium and full filtering.

The ranging amplifier is a unity-gain potentiometric amplifier having a floating FET input. It has a high input impedance and low output impedance. The amplifier is comprised of transistors Q4 through Q11 and associated circuitry. The input to FET Q4 is limited to +0.7 volts by Q6. The feedback path is from R54 (the Input Amplifier ZERO adjustment control) to one side of Q4. Potentiometer R20 is a balance adjustment and is adjusted at the factory.

If no Sample and Hold Assembly is installed the output voltage of the ranging amplifier at TP5 is applied through jumpers F-G and G-H to series resistors R16 and R21 causing a current to flow in the error summing junction. The same voltage is applied through terminal 63 to the inverting negative amplifier on the Reference Amplifier Assembly. If a Sample and Hold Assembly is installed the output of the ranging amplifier is applied through jumper H-G and terminal 55 to the Sample and Hold Assembly. The output of the Sample and Hold Assembly is applied to the summing junction through terminal 63 and also to the inverting negative amplifier on the Reference Amplifier Assembly. When the input to the instrument is negative, the positive output of the negative amplifier is received at terminal 61 and drives series resistors R15 and R22. Resistor R22 is half the value of R21. The input current through R22 and R15 is summed with the input current through R16 and R21 and the difference is always positive. Resistors R21 and R22 are part of a matched set which includes R1 through R20 on the Decoder Subassembly. The negative currents from the Decoder Subassembly are received at terminal 59 and are summed with the positive input currents to develop drive signals for the comparator section. A negative sum at the summing junction indicates that the Decoder Subassembly output is larger than the input signals.

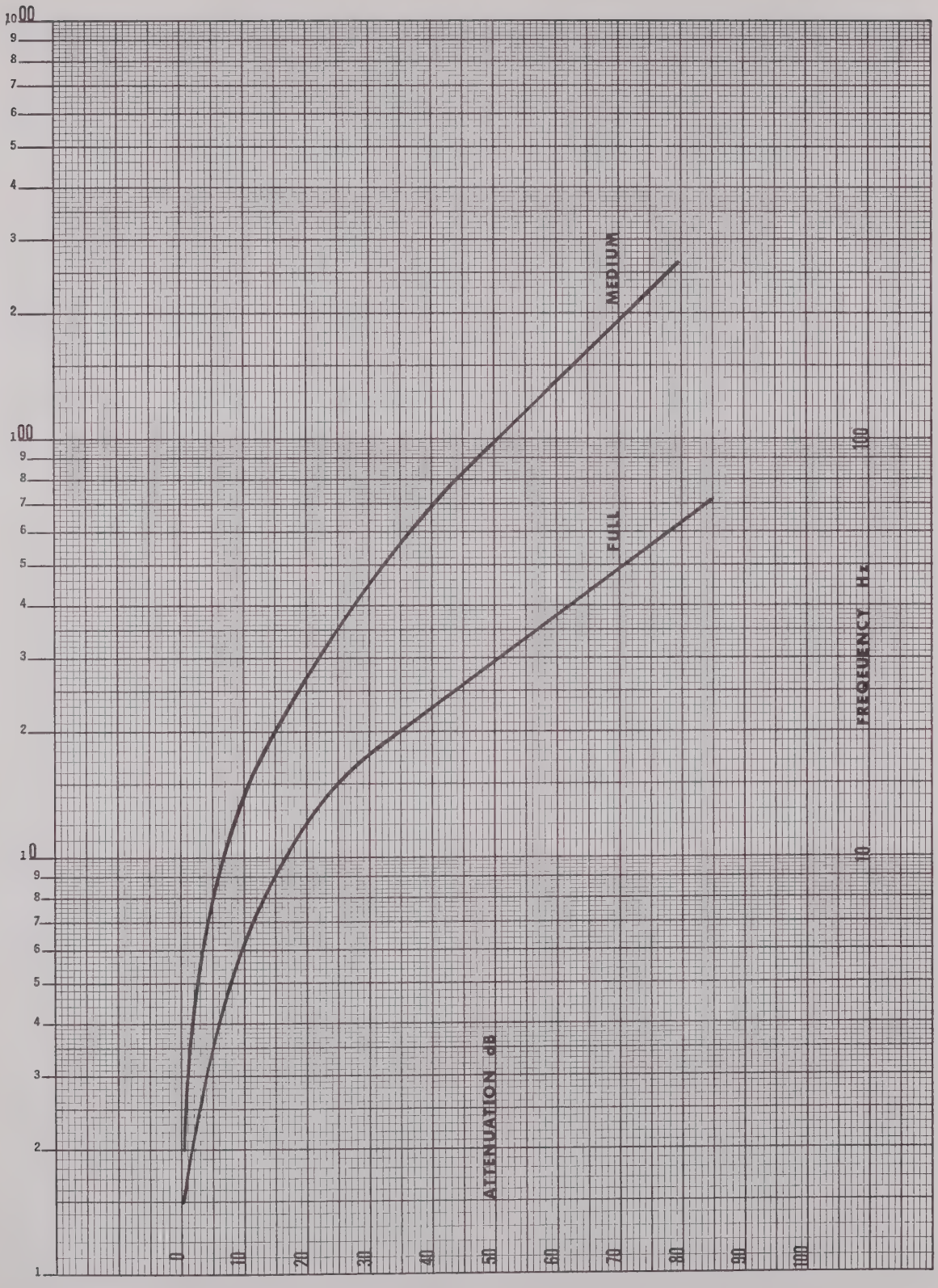


Figure 5-5. Filter Response.

In the comparator section, the sum of the currents is amplified and inverted by A2 and applied to the input of A3. The successive approximation waveform may be seen with an oscilloscope at test point TP4. The input to A3 is amplified, inverted, and applied to transistor switch Q14.

When the input to amplifier A2 is negative, A3 has a negative output which turns off Q14 and terminal 67 becomes high. When the input to A2 is positive, A3 has a positive output which turns on Q9 and F01 becomes low. A high F01 command indicates to the Decade Assembly that the current provided by the Decoder Subassembly is too large and must be changed for the next smaller current. A low F01 indicates that the current is smaller than the input and must not be removed.

Limiting diodes CR12 and CR13 prevent the input of A2 from exceeding ±0.7 volt and the network of CR6 through CR11 prevents the output of A2 from exceeding ±6 volts. Potentiometer R41 is the zeroing adjustment and R24 the offset adjustment for amplifier A2. Zener diodes CR19 through CR22 drop the +22 volts and the −22 volts to the proper operating potentials for A1 and A3. The +15 volts and the −15 volts used by amplifier A2 is applied through terminals 77 and 75 to the negative amplifier on the Reference Amplifier Assembly.

PROGRAM CONTROL ASSEMBLY (Diagram 6)

The Program Control Assembly controls the conversion rate and the logic sequence of the Model 6653A. The inputs and outputs of the Program Control Assembly are listed in table 5-5.

Table 5-5. Program Control Assembly Inputs and Outputs.

INPUT(S)	TERMINAL(S)	RECEIVED FROM ASSY.
$\overline{\text{PRINT START}}$	53	Print Control
$\overline{\text{EXT START}}$ $\overline{\text{CONTROL}}$, EXT START PULSE	49, 57	Remote No. 1 or DTL Print Output No. 1
$\overline{\text{PRINT OFF}}$	69	PRINT OFF Switch or Remote No. 2
F01	63	Input Amplifier
OUTPUT(S)	**TERMINAL(S)**	**DESTINATION ASSEMBLY(IES)**
$\overline{\text{DELAYED F02}}$, $\overline{\text{P01}}$, $\overline{\text{P03}}$ to $\overline{\text{P19}}$, GATED CLOCK	7, 1, 5, 9, 15, 23, 29, 35, 37, 45, 47, 51, 55, 61, 65, 67, 71, 73, 75, 59	Decade
CLOCK	21	Print Control, Autorange
RATE OSC	13	Remote No. 2
SP	79	Sample and Hold
$\overline{\text{P20}}$	77	Print Control, DTL Print Output No. 1 and No. 2, Remote No. 1, Sample and Hold

The conversion rate of the instrument is controlled by either the front panel POWER-RATE control, the Print Control Assembly, or external commands through the Remote No. 1 Assembly. The front panel RATE control determines the RC time constant of the rate oscillator comprised of C1 and Q2 through terminals 17 and 19. Each time the charge on C1 rises to the required level, unijunction Q2 fires and discharges C1 through R3. The voltage developed across R3 momentarily cuts off Q4 providing a start pulse through ZA9 and ZA10 to ZB2, the clock gate. The start pulse is also applied to terminal 79. The RATE control can be varied to cause the rate oscillator to provide from one to five start pulses per second.

When the instrument is operated in a print mode, terminal 69 becomes high and disables the rate oscillator.

The conversion rate is controlled by the Print Control Assembly applying low start pulses to terminal 53. The start pulse is passed by ZB1, ZA9, and ZA10 to the clock gate.

When the conversion rate is controlled externally, terminal 49 is held low through the Remote No. 1 Assembly to disable the rate oscillator and the print start. The external start pulse is applied through the Remote No. 1 Assembly to terminal 57 and passed by ZA10 to the clock gate. When controlled by an external start source the instrument can make measurements up to 1000 times per second.

Transistors Q1 and Q5 comprise the master-clock multivibrator which is free-running at a 50 KHz rate. Integrated circuits ZA6 and ZA8 shape the multivibrator output to high pulses which are 2 microseconds wide and occur every 20 microseconds.

The clock gate flip-flop (ZB2) sets upon receipt of a start pulse. The clock gate then passes clock pulses (gated clock) until it is reset by pulse P20 (conversion complete) from waveshaping circuit ZA7.

The gated clock is applied to the program counter which is comprised of integrated circuits ZA1 through ZA5. The output of the program counter is decoded to produce program pulses $\overline{P01}$ to $\overline{P19}$ which are 20 microseconds wide and occur in numerical sequence. The static state of the counter (P20) is established when ZA1, ZA2, and ZA3 are reset (9-output high) and ZA4 and ZA5 are set (6-output high). The first gated clock pulse sets ZA1, ZA2, and ZA3 and resets ZA5. By decoding the conditions of counters ZA1, ZA2, ZA3, and ZA4, $\overline{P01}$ is developed and P20 goes low. The second gated clock pulse resets ZA4. This establishes $\overline{P02}$ time which is not used. The third gated clock pulse resets ZA3, developing $\overline{P03}$. A similar sequence is continued for the development of the remaining program pulses except that ZA1 and ZA2 do not have a gated clock input. ZA2 changes state whenever ZA3 is reset. ZA1 changes state whenever ZA2 is reset. After $\overline{P19}$ time, P20 becomes high and stays high until another start pulse applies the gated clock to the program counter.

When the instrument is initially energized, transistor Q3 provides a false start pulse which cycles the counter to the P20 condition, thus preparing it for operation.

F01 pulses are received at terminal 63, AND-gated with the gated clock, delayed 4 microseconds by integrated circuit ZB3, and OR-gated with $\overline{P01}$. The DELAYED F02 pulse is applied to terminal 7.

For a description of the timing sequence of events occurring during a measurement and conversion cycle, refer to the paragraph titled Conversion Timing Sequence.

DECADE ASSEMBLY (Diagram 7)

The Decade Assembly utilizes the program pulses and F02 DELAYED signals to control the setting and resetting of the BCD drive pulses. It also generates up and down range information.

The inputs and outputs to the Decade Assembly are listed in table 5-6.

Flip-flops ZB1, ZB2, ZB3, and ZB4 represent the BCD 8-, 4-, 2-, and 1-weighted bits of the thousands decade. The remaining flip-flops similarly represent the hundreds, tens, and units decades.

When the reset pulse $\overline{P01}$ is received at terminal 1 it is applied through the OR gates of the flip-flops in each decade and AND-gated with the F02 DELAYED signal on terminal 7. The outputs of the AND gates reset the decade flip-flops.

At $\overline{P03}$ time terminal 3 goes low, ZB1 is set causing terminal 5 to go high. If an F01 signal is generated by the comparator during $\overline{P03}$ time, it causes the Program Control Assembly to generate F02 DELAYED which is delayed until the start of $\overline{P04}$. Program pulse $\overline{P04}$ is AND-gated with the F02 DELAYED signal to reset the ZB1 flip-flop. The F02 is delayed to allow the set pulse $\overline{P03}$ time to go low, thereby preventing set and reset commands being applied simultaneously to the same flip-flop. If F02 DELAYED is not received during $\overline{P04}$, ZB1 remains set. Program pulse $\overline{P04}$ also sets ZB2 which remains set unless F02 DELAYED comes high during $\overline{P05}$. All other flip-flops operate in a similar manner.

The GATED CLOCK on terminal 59 is applied to the gated clock delay circuit. The gated clock pulses are delayed approximately 2-1/2 microseconds for synchronization with the program pulses and applied through pin 6 of ZA4 to the logic lock-out circuits.

Table 5-6. Decade Assembly Inputs and Outputs.

INPUT(S)	TERMINAL(S)	RECEIVED FROM ASSY.
$\overline{P03}$ to $\overline{P19}$, F02 DELAYED, GATED CLOCK	1, 3, 9, 17, 23, 29, 35, 37, 45, 47, 52, 55, 61, 65, 69, 73, 76, 78, 7, 59	Program Control
$\overline{AUTO\ O.R.}$, $\overline{AR4}$	21, 54	Autorange
OUTPUT(S)	**TERMINAL(S)**	**DESTINATION ASSEMBLIES**
D2 to D5	5, 13, 25, 31	Display Driver No. 2, Decoder, Print Output No. 2 and 3
D6 to D9	33, 39, 41, 49	Display Driver No. 1, Decoder, Print Output No. 2 and 3
D10 to D17	51, 53, 57, 63, 67, 71, 75, 77	Display Driver No. 1, Decoder, Print Output No. 2
$\overline{UP}$, $\overline{DN}$	15, 11	Autorange, Remote No. 1, Print Control
$\overline{P01}$	64	Reference Amplifier, Display Driver No. 2

The logic lock-out circuits prevent logic errors when the input is greater than the range currently selected. For example, in the 10-volt range with a 100-volt input, the thousands decade 8-weighted bit and 4-weighted bit both set does not cause an F02 DELAYED because the decoder output is less than the 100-volt input. The delayed gated clock, D2, and $\overline{P05}$ are AND-gated to reset the 4-weighted bit. There is a similar lock-out gate in each decade. All except the thousands decade also have similar lock-out gates for the 2-weighted bits when the 8-weighted bit is set. The AND gate which is shown directly below ZB4 is the logic lock-out for the thousands decade 1-weighted bit and functions when the 8- and 2-weighted bits are set except when in AUTORANGE.

When in AUTORANGE, terminal 21 is low disabling the thousands decade 1-weighted bit logic lock-out. If the input signal exceeds the full-scale range, the 8-, 2-, and 1-weighted bits of the thousands decade set and pins 1, 4, and 5 of ZA2 go high. At $\overline{P19}$ time, pin 2 of ZA2 also goes high and an up-range pulse is applied to terminal 15. When the Autorange Assembly is in the highest range for the function selected, or when in a manually selected range, terminal 21 goes high. When terminal 21 is high, the thousands decade 1-weighted bit logic lock-out disables the up-range pulses.

A down-range pulse applied to terminal 11 is generated during $\overline{P19}$ time when a zero is set in the thousands decade or when the thousands and units decades have a 1 set, the hundreds decade has a zero set, and the instrument is not in the AR4 range. The state of the tens decade is not utilized to generate down-range pulses.

DECODER SUBASSEMBLY (Diagram 8)

The Decoder Subassembly utilizes the D2 through D17 pulses from the Decade Assembly to operate solid-state switches which control the negative current input to the error summing junction on the Input Amplifier Subassembly.

The switch transistors in the Decoder Subassembly 1K SWITCH cause an effective short when actuated. For example, when transistor Q13 is driven into saturation, the voltage drop across the emitter-base junction is 0.7 volt. The base-collector junction becomes forward biased at this time and the base-collector voltage drop is approximately 0.3 volt and of opposite polarity to the drop across the emitter-base junction. A 0.56 ohm resistor (R53) is in the collector circuit to increase the base-to-analog-common voltage drop to 0.7 volt. The drops being equal and of opposite polarity cancel each other and the effective emitter-to-analog-common drop is zero. Transistors Q14 through Q20 operate in a similar manner. The 0.4-volt offset is insignificant to the other switches so there are no collector resistors.

Transistors Q13 and Q17 are the switching transistors for the 8-weighted bit of the 1K SWITCH. In the static state, Q13 is turned on by Q1, and there is no output from R4 to the summing junction. When terminal 5 goes high, Q1 is turned off, cutting off Q5, which turns on Q9. Transistor Q9 drives the bases of Q13 and Q17 negative turning off Q13 and turning on Q17 which switches the input of R4 to –11.000 volts. Negative current flows to the error summing junction through terminal 59. The other switches in the 1K SWITCH operate in a similar manner.

The hundreds, tens, and units (H, T, and U) switches operate in a similar manner except for the method of driving the switches. In the static state, for example, the bases of Q33 and Q45 are held positive by the voltage divider from –22 volts to +22 volts. When D6 goes high, transistor Q21 cuts off, removing the series path through R89 and Q21 which was around R113. This causes the bases of Q33 and Q45 to go negative. The negative voltage cuts off Q33 and turns on Q45 which applies –11.000 volts to R9.

Resistors R5 adds to the resistance of R9, R8, R7, and R6 so the current from the hundreds switches is one tenth the current from the 1K switches. Resistors R10 and R15 perform the same function for the tens and units switches.

Any change in the –11.000 volts is sensed at the inputs to the 1K SWITCH and the change is fed back through terminal 7 to the Reference Amplifier Assembly which corrects its output to –11.000 volts.

Resistors R1 through R20 are a ratio-matched set. Resistors R21 and R22 on the Input Amplifier Subassembly are also part of this set.

REFERENCE AMPLIFIER ASSEMBLY (Diagram 9)

The Reference Amplifier Assembly is comprised of the –10.000 volt reference supply, the reference amplifier, the negative amplifier, and the polarity flip-flop.

The inputs and outputs of the Reference Amplifier Assembly are listed in table 5-7.

Table 5-7. Reference Amplifier Assembly Inputs and Outputs.

INPUT(S)	TERMINAL(S)	RECEIVED FROM ASSY.
AMP 1	55	Input Amplifier or Sample and Hold
F01	67	Input Amplifier
$\overline{\text{P01}}$	65	Decade
$\overline{\text{RATIO}}$	9	FUNCTION Switch or Remote No. 2
$\overline{\text{EXT REF SEL}}$	7	Remote No. 1
EXT REF COM, EXT REF	3, 1	J1R-C and E
–SENSE	15	Decoder
$\overline{\text{DR4}}$, $\overline{\text{DR5}}$, $\overline{\text{DR6}}$	13, 25, 17	Display Driver No. 2
$\overline{\text{NF}}$, $\overline{\text{FF}}$	31, 37	FILTER Switch or Remote No.2
OUTPUT(S)	**TERMINAL(S)**	**DESTINATION ASSEMBLY(IES)**
–POL	71	Display Driver No. 1
+POL	73	Display Driver No. 1, Print Output No. 1
–8, AMP 2, 10V, 100V, 1000V, NOTCH FILTER, LP FILTER	27, 61, 19, 23, 21, 33, 35	Input Amplifier
–11	47	Decoder, MV/Ohms Converter

Transistors Q2 and Q3 comprise a series-regulator power supply. The –8-volt output provides coil supply voltage for relay coils L1 and L2. The –8 volts is also applied to terminal 27. Transistor Q4 is normally on, energizing relay coil L1 which closes S1.

Transistor Q1 and associated circuitry comprise a precision, temperature-compensated, –10.000-volt reference. The output of the reference is applied across S1 to one base of dual transistor Q9. The amplifier, consisting of Q9 through Q14, has a gain of 1.1, so the –10.000 volt input produces a –11.000 volt output to terminal 47. Any error in the –11.000 is sensed at the Decoder Subassembly and fed back through terminal 15 and REF ADJ R31 to the other base of Q9.

When the instrument is operated in RATIO function, or when the external reference is selected through the Remote No. 1 Assembly, terminal 7 or 9 is grounded, turning on Q5. Transistor Q5 energizes L2 and turns off Q4. The –10.000-volt internal reference is disconnected and an external reference must be applied through the front or rear panel INPUT connector to terminals 1 and 3. The external reference is amplified 1.1 times, and applied to terminal 47. The value of the external reference may be from –1 to –10 volts. The accuracy of the instrument is degraded, however, when the reference is less than –10 volts.

The AMP 1 input signal is received from the Input Amplifier Subassembly terminal 63 (SH OUT) when there is no Sample and Hold Assembly installed. If a Sample and Hold Assembly is installed the AMP 1 input is received from terminal SH OUT on the Sample and Hold Assembly. AMP 1 applies the input signal through terminal 55 to the input of the unity-gain, inverting, negative amplifier (integrated-circuit amplifier A1). Amplifier A1 amplifies both positive and negative input signals. Diode CR13 in the output circuit, however, passes only the inverted positive outputs through terminal 61 to the Input Amplifier Subassembly for summing with the Decoder Subassembly output. The gain of the amplifier is set by R16 NEG GAIN and the offset is adjusted by R32 NEG BAL.

When terminal 65 goes low it is delayed approximately 10 microseconds by C1 and the low output of Z3-8 is applied to the base of Q6. Transistor Q6 turns off applying +12 volts to the input of A1 which slews the negative amplifier to cutoff. The same pulse at terminal 65 applied through Z1 sets the polarity flip-flop Z2 to a high state. The Decoder Subassembly output is low at this time so if the input signal is high, the Input Amplifier Subassembly comparator produces no output and the polarity flip-flop remains in the high state with a drive signal at terminal 73. If the input signal is low, however, the comparator produces an input at terminal 67. The high signal at terminal 67 is AND-gated with the inverted low pulse on terminal 65 and the polarity flip-flop is reset causing a drive signal at terminal 71. At the end of $\overline{P01}$ time the slew voltage to the amplifier is removed and the amplifier uses $\overline{P02}$ (not shown on diagram) time to stabilize.

Transistors Q15 through Q19 are driven by low pulses received on terminals 13, 25, 17, 31, and 37. The outputs are used to drive the range and filter reed relays on the Input Amplifier Subassembly. Zener diodes CR16 and CR18 drop the –22-volts and +22 volts to the proper operating potential for A1.

CONVERSION TIMING SEQUENCE (Diagram 10)

Diagram 10 shows a typical conversion timing sequence with the input leads shorted (0.000 input). The clock pulses are present at Program Control Assembly TP1 CLOCK at all times. When a start pulse is applied to the instrument $\overline{START}$ ZA10-12 goes low and the CLOCK GATE F/F ZB2-11 sets. This enables a gate which provides the clock pulses to the Decade Assembly GATED CLOCK TP-2 and through a delay circuit to DELAYED CLOCK ZA4-6. The enlarged view in the upper corner of the diagram shows the time relationship between the gated and delayed clock pulses.

Flip-flops ZA1 through ZA5 of the Program Control Assembly also utilize the gated clock pulses to produce program pulses $\overline{P01}$ through $\overline{P19}$. The program pulse outputs are provided through individual terminals to the Decade Assembly: $\overline{P01}$ is through terminal 1, $\overline{P03}$ through 5, $\overline{P04}$ through 9, etc.

At $\overline{P01}$:

1. P20 goes low which sets Program Control Assembly flip-flops ZA1, ZA2, and ZA3 and resets ZA5.

2. F02 DELAYED comes high which resets all flip-flops in the Decade Assembly for a Decoder Subassembly output of 0 volts.

3. Reference Amplifier Assembly Z1-6 goes low setting the polarity flip-flop to the high state and clamping it.

4. After Reference Amplifier Assembly capacitor C1 charges, POL SLEW Q6-C (collector of Q6) is set to +12 volts.

   a. POL SLEW Q6-C causes –AMP A1 to slew to –11 volts.

   b. NEG AMP A1 output causes NEG AMP OUT TP1 to go to essentially 0 volts.

5. After Reference Amplifier capacitors C9 and C10 charge, Z1-6 goes high unclamping the polarity flip-flop.

This leaves only the input signal at the input to the Input Amplifier Subassembly comparator. The input signal is 0.000, however, and there is no comparator output to reset the polarity flip-flop which remains in the high state. At the end of $\overline{P01}$ time, the Reference Amplifier Assembly POL SLEW returns to 0 volts, the –AMP A1 output returns to 0 volts, Program Control DELAYED F02 goes low, and the instrument stabilizes during $\overline{P02}$ time.

At $\overline{P03}$, the first Decade Assembly output (D2) sets. Each following program pulse sets a Decade Assembly output. The Decade Assembly outputs are through individual terminals: D2 is through terminal 5, D3 through 13, etc. Because the input is 0.000, a DELAYED F02 is produced to reset each Decade Assembly output. The time relationship of DELAYED F02 to the clock pulses is shown in the upper corner of the diagram.

Although the instrument does not change ranges with a 0.000 input, the Decade Assembly UP or DOWN RANGE at P19 is indicated as an example.

At the end of P19, P20 goes high and the CLOCK GATE F/F resets.

DISPLAY DRIVER NO. 2 ASSEMBLY (Diagram 11)

The Display Driver No. 2 Assembly produces overrange, thousand decade, decimal point, and range drive signals, provides SIGN INHIBIT commands, out-of-range indications, and control for range relays on other assemblies. It also provides AUTO COM to inhibit the RANGE switch when the REMOTE switch is depressed.

The inputs and outputs of the Display Driver No. 2 Assembly are listed in table 5-8.

Drive pulses from the thousand decade, of the Decade Assembly, are received at terminals 5, 9, 21, and 25 and applied to AND-gates on ZB4. The outputs are inverted by ZB6 and applied to terminals 33, 35, 37, and 39. When the thousand decade has 8- and 2-weighted outputs, terminals 5 and 21 go high causing ZB2-3 to go low, disabling the AND-gates on ZB4, and terminal 27 goes high to drive the overrange indicator. When terminals 33, 35, 37, and 39 go low they cause the thousand decade to indicate zero.

When the input voltage exceeds the manually selected range scale or the highest range available in autorange by more than 10 percent, terminals 25 and 34 inputs will be low causing the flip-flop on ZB5 to reset and pin 8 becomes high. The high output is applied to terminal 24 as an out-of-range indication, and also enables the free running multivibrator on ZB3. The changing state of the output applied to terminal 27 will cause the overrange indicator to blink indicating an out-of-range condition.

When in AUTORANGE mode terminal 41, 45, 49, 53, 57, or 60 is controlled by the Autorange Assembly. Terminal 43, 47, 51, 55, 58, or 61 is controlled by the RANGE switch, when in a manually-selected range, or by an external drive source, when in REMOTE. When a range is selected, in any mode, the low input is applied to an OR-gate on ZB7 or ZB8. The high output is applied to AND-gates on ZA4 through ZA7 and ZA9. The AND gates are enabled by terminal 1, 15, 7, or 11. In $\overline{AC}$ or $\overline{K\Omega}$ ZA6-11, ZA5-3 and ZA7-3 are enabled by the high output of ZA3-6. The output applied through OR-gates is AND-gated with the high signal on terminal 40 when not in REMOTE. The outputs are applied to terminal 62, 63, 75, 78, or 82. If in REMOTE mode terminal 40 will be low and disable the AND-gates on ZA4, ZB9, ZA7,

Table 5-8. Display Driver No. 2 Assembly Inputs and Outputs.

INPUT(S)	TERMINAL(S)	RECEIVED FROM ASSEMBLY
D2, D3, D4, D5	5, 9, 21, 25	Decade
$\overline{P01}$	32	Decade
F01	34	Input Amplifier
$\overline{\text{REMOTE DEC CONTROL}}$, $\overline{RD1}$, $\overline{RD2}$, $\overline{RD3}$, $\overline{RD4}$, $\overline{RD5}$	40, 16, 64, 73, 77, 80	Remote No. 1
$\overline{AR1}$, $\overline{AR2}$, $\overline{AR3}$, $\overline{AR4}$, $\overline{AR5}$, $\overline{AR6}$	41, 45, 49, 53, 57, 60	Autorange
$\overline{MR1}$, $\overline{MR2}$, $\overline{MR3}$, $\overline{MR4}$, $\overline{MR5}$, $\overline{MR6}$	43, 47, 51, 55, 58, 61	RANGE Switch or Remote No. 1
$\overline{AC}$, $\overline{K\Omega}$, $\overline{RATIO}$, $\overline{DC\ (V)}$	11, 7, 15, 1	FUNCTION Switch or Remote No. 2
$\overline{\text{AUTO COM}}$	22	REMOTE Switch
OUTPUT(S)	**TERMINAL(S)**	**DESTINATION ASSEMBLY(IES)**
AUTO COM	36	RANGE Switch
K1, K2, K4, K8, KD1A, KD1B, KD2, KD3, KD4, KD5	39, 37, 35, 33, 29, 31, 74, 76, 79, 81	Display Driver No. 1
KOR (OR), SIGN INHIBIT	27, 23	Display Driver No. 1, Print Output No. 1
$\overline{\text{PRINT DEC 1}}$, $\overline{\text{PRINT DEC 2}}$, $\overline{\text{PRINT DEC 3}}$, $\overline{\text{PRINT DEC 4}}$, $\overline{\text{PRINT DEC 5}}$,	62, 63, 75, 78, 82,	Print Output No. 1, Print Control
$\overline{CR1}$, $\overline{CR5}$	72, 65	MV/Ohms Converter
$\overline{CR2}$, $\overline{CR3}$, $\overline{CR4}$	71, 69, 66	MV/Ohms and AC Converters
$\overline{DR4}$, $\overline{DR5}$, $\overline{DR6}$	13, 19, 17	Reference Amplifier
$\overline{RW1}$	3	REMOTE Switch, Remote No. 1
$\overline{RW2}$	2	REMOTE Switch, Remote No. 1, Print Control
OOR	24	Print Output No. 1

and ZB11 and the decimal point position will be controlled by terminal 16, 64, 73, 77, or 80. Terminal 29, 31, 74, 76, 79, or 81 control the decimal drive transistors on Display Driver No. 1 Assembly. The $\overline{AC}$ or $\overline{K\Omega}$ input is applied through an OR-gate and inverter to terminal 23 to inhibit the polarity sign indication and printout.

The low input to terminal 22 is received from normally open contacts of the REMOTE switch, inverted by ZA1-3 and the high output is applied through terminal 36 to the RANGE switch. This disables front panel control of the RANGE switch when in REMOTE.

The range input on terminal 41, 45, 49, 53, or 57 or 43, 47, 51, 55 or 58 is applied to AND-gates on ZA8 or ZA9. The AND-gates are enabled by the high signal on terminals 1 and 15 applied through an OR-gate and inverter on ZA3. The low output is applied to terminal 65, 66, 69, 71, or 72.

When either terminal 1 or 15 go low the high output of OR-gate ZA3-3 is AND gated with either terminal 53, 57, or 60 or 55, 58, or 61 and the low output is applied to terminal 13, 17, or 19. When the AC Converter or MV/Ohms Converter Assembly is in use the 10-volt DC V range is set by inverter ZA2-1.

Terminal 2 or 3 is used as range common. Terminal 3 is low when in DC V or RATIO function and terminal 2 is low for all other functions.

DISPLAY DRIVER NO. 1 ASSEMBLY (Diagram 12)

The Display Driver No. 1 Assembly decodes the function, polarity, decimal point, and numerical readout drive information to drive the front panel indicators and connects the print delay capacitor(s) to a print delay potentiometer on the Print Control Assembly in DC V, RATIO, or MV functions.

The inputs to the Display Driver No. 1 Assembly are listed in table 5-9.

The function indicator lights on the front panel are driven by Q1 through Q5. If, for example, the KΩ function is selected, terminal 77 goes low, causing Q3 to turn on and apply +5 volts out terminal 73 to the KΩ indicator.

Table 5-9. Display Driver No. 1 Assembly Inputs.

INPUT(S)	TERMINAL(S)	RECEIVED FROM ASSY.
$\overline{\text{EXT REF SEL}}$	66	Remote No. 1
$\overline{\text{RATIO}}$, $\overline{\text{AC}}$, $\overline{\text{K}\Omega}$, $\overline{\text{MV}}$, $\overline{\text{DC}}$ ($\overline{\text{V}}$)	68, 70, 77, 81, 85	FUNCTION Switch or Remote No. 2
$\overline{\text{FF}}$	82	FILTER Switch or Remote No.2
$\overline{\text{SIGN INHIBIT}}$, KOR, KD1A, KD1B, KD5, KD4, KD3, KD2, K1, K2, K4, K8	63, 59, 57, 55, 5, 7, 9, 11, 47, 49, 51, 53	Display Driver No. 2
D6 to D17	43, 41, 39, 37, 33, 31, 29, 27, 25, 23, 19, 17	Decade
DDC, CDC	67, 75	Print Control
+SIGN, –SIGN	15, 13	Reference Amplifier

When terminal 15 is high it causes CR4 to cut off which enables CR5 to conduct. When CR5 conducts, Q8 turns on and illuminates the + indicator. The – indicator operates in a similar manner. When operating in AC or KΩ, terminal 63 is held low. This causes CR6 and CR8 to conduct, disabling both polarity sign inputs.

When terminal 59 is driven high Q10 turns on, illuminating the 1 indicator in DS2. All other numeral indicators in DS2 are disabled by a connection to approximately +100 volts. The overrange indicator is therefore either 1 or blank.

The decimals are lighted in a similar manner by terminals 57, 55, 11, 9, 7, and 5 signals.

When the UNITS indicator decoder is driven by binary coded signals on terminals 25, 23, 19, and 17 it

drives the 1 through 9 indicators in DS3. If none of the inputs are high, the zero indicator is illuminated. Diodes CR23 through CR32 protect the outputs of the integrated circuit decoder from the high positive potentials present in the indicator tubes. The TENS, HUNDREDS, and 1K indicators operate in a similar manner.

When $\overline{FF}$ and either $\overline{DC\ V}$, $\overline{MV}$, or $\overline{RATIO}$ are present, ZA5 controls the operation of S1 and S2, which connect the Print Control Assembly print delay capacitor(s) from terminals 67 and 75 through terminals 71 and 80 to a print delay potentiometer on the Print Control Assembly.

AUTORANGE ASSEMBLY (Diagram 13)

When enabled by the front panel AUTORANGE switch, the Autorange Assembly controls the range of the instrument by responding to the up and down range commands from the Decade Assembly and indicates to the Decade Assembly when it is in the highest range for the function selected. The Autorange Assembly also indicates to the Decade Assembly when it is in a manually selected range.

The inputs and outputs of the Autorange Assembly are listed in table 5-10.

The Autorange Assembly contains six range flip-flops, ZB4 through ZB9. The MV function utilizes ZB5 through ZB7, RATIO and DC V utilizes ZB7, ZB8, and ZB9, KΩ utilizes ZB4 through ZB8, AC utilizes ZB4 through ZB7 and MV/DC (V/MV) utilizes ZB5 through ZB9.

When the AUTORANGE switch is depressed, or if the switch was depressed when the instrument was turned on, terminal 65 goes low. After a delay, determined by the charge time of C1, ZB10-6 goes high, unclamping the range flip-flops, and a false down pulse is generated at ZA12-11. When not autoranging the range flip-flops are held in a reset state by the low output of ZB10-6.

A down pulse (false or through terminal 11) is applied through OR-gates to the clocked reset input of the range flip-flops, ZB4 through ZB7, through AND-gate ZA8-6 to reset input of ZB8, and also inverted by ZA10-3 and applied to the reset input of ZB9. This ensures that the range flip-flops will be reset with every down pulse. The output of ZA10-3 is applied to a delay circuit on ZA11.

Table 5-10. Autorange Assembly Inputs and Outputs.

INPUT(S)	TERMINAL(S)	RECEIVED FROM ASSY.
$\overline{AC}$, $\overline{MV}$, $\overline{RATIO}$, $\overline{DC\ (V)}$, $\overline{K\Omega}$, $\overline{MV/DC\ (V/MV)}$	13, 5, 17, 1, 9,3	FUNCTION Switch or Remote No. 2
$\overline{AUTO}$	65	RANGE Switch or Remote No. 1
$\overline{DN}$, $\overline{UP}$	11, 15	Decade
CLOCK	21	Program Control
OUTPUT(S)	**TERMINAL(S)**	**DESTINATION ASSEMBLY(IES)**
$\overline{AR1}$, $\overline{AR2}$, $\overline{AR3}$, $\overline{AR5}$, $\overline{AR6}$	41, 45, 49, 57, 61	Display Driver No. 2
$\overline{AR4}$	53	Display Driver No. 2, Decade
$\overline{AUTO\ O.R.}$	23	Decade

This circuit delays the high output of ZA10-6, from the trailing edge of the down pulse, to allow completion of the resetting of the range flip-flops. The output of ZA10-6 is AND-gated with the function information to set the basic range for the function selected. If in a DC V function, for example, ZA7-8 sets ZB7 which is the 10 volt DC V range. If the function is changed pin 1, 2, 4, or 5 of ZA3 or pin 1 of ZA4 goes low, generating a false down pulse at ZA2-6 which sets the basic range for the function selected, as described above.

Assume the instrument is up ranging from the 10-volt scale to the 1000-volt scale. In the 10-volt range, ZB7 is set with the high output on pin 6 being applied to ZB8-3 and ZA8-9. The DC V input is passed through an OR-gate ZA4-11 to ZA9-1 and also inverted and passed through OR-gate ZA4-6 and applied to ZA8-10. When an $\overline{UP}$ pulse is received, it is inverted and triggers AND-gate ZA8-8, is inverted by OR-gate ZA7-6, and causes ZB7

to reset. The $\overline{UP}$ pulse also triggered AND-gate ZA9-3, was inverted by OR-gate ZA9-6 and caused ZB8 to set. The high output of pin 6 is applied to pin 13 of AND-gate ZB12. The low output of ZB8-9 is applied to a pulse generator consisting of C12 and inverter ZB13-6. The pulse is inverted by ZB13-8, applying a low pulse to AND-gate ZB12-6. The high output of ZB12-6 turns on Q1, and capacitor C13 starts to charge, turning off Q2. The output of Q2 is inverted, applying a low pulse back to AND-gate ZB12 disabling the gate until C13 is charged. The low output of ZB12-3 is also applied to pin 12 of ZB12, disabling the AND-gate applying a low pulse to ZB9-4. The duration of the charge time for C13 will prevent ZB9 from being set with the next $\overline{UP}$ pulse. When C13 is charged, Q2 turns on and the high output of ZB12-3 triggers AND-gate ZB12-11, allowing ZB9 to be set with the next $\overline{UP}$ pulse. Therefore, two $\overline{UP}$ pulses must be generated to cause the instrument to up-range between the 100-volt and 1000-volt scale.

When the MV/DC (V/MV) FUNCTION switch is depressed, terminal 3 goes low. This low pulse is inverted by ZB1-11, inverted again by ZA1-8, and applied to the delay circuit of ZA2. A false down pulse is generated and all range flip-flops are reset. Pin 8 of ZA1 will remain low as long as the MV/DC (V/MV) FUNCTION switch is depressed preventing the generation of false down pulses as instrument changes between DC V and MV readings. The low signal at terminal 3 is also inverted by ZB1-3 and applied to ZB2-4 and 1. If ZB3 is in the set condition this signal is AND-gated with the output of ZB3 and ZA7-8 is enabled through OR-gate ZA4-11. The false down pulse is also applied to the delay circuit on ZA11 and the output of ZA11-8 is inverted and the high output of ZA10-6 triggers ZA7-8 setting ZB7. The output of ZB7-9 is applied to inverter ZA6-11 and, after a delay caused by the charging of C10, applies a high signal to ZB3-3 and 12.

When a $\overline{DN}$ pulse is received, all the range flip-flops are reset. The down pulse is also delayed through ZA11 and the output sets ZB7. The low output of ZA7-8 is applied to an OR-gate on ZB2 and the high output is applied to ZB3-2. When the down pulse reset all the range relays, ZB7-9 went high, was inverted by ZA6-11, and C10 began discharging through R3. The rate of discharge for C10 is delayed sufficiently, keeping ZB3-3 and 12 high, to allow the high pulse applied to ZB3-2 to reset ZB3. The outputs of ZB3 now disables ZB2-3 and triggers ZB2-6. The instrument is now in the 1000 millivolt range. When ZB2-6 went low it enabled ZA5-8 so with the next down pulse the instrument will be placed in the 10 millivolt range. When the output of ZB2-3 or 6 goes low it is applied to terminals 1 or 5 to illuminate the proper function light and position the decimal point via the Display Drivers. Similar up or down ranging is accomplished in a similar manner as described above.

When the instrument is in the highest range for the function selected, the set output of ZB7, ZB8, or ZB9 is AND-gated with the function on ZA6. The low output of ZA6 is applied to ZB2-10, via an inverter and OR-gate, and terminal 23 goes high. When terminal 23 is high, the 1-weighted bit of the thousand decade is disabled, on the Decade Assembly, disabling the up-range pulses. When in a manually-selected range the input to ZB2-9 will be low and the high output on terminal 23 will be indicated at the Decade Assembly.

The autorange information on terminals 41, 45, 49, 53, 57, and 61 is used to control the instrument range and front panel decimal point indication.

PRINT CONTROL ASSEMBLY (Diagrams 14 and 15)

NOTE

The front panel PRINT OFF pushbutton must be depressed unless the print output capability is being utilized.

The Print Control Assembly, when enabled:

1. Establishes a settling time for the instrument. The amount of settling time depends upon the function selected.
2. Issues a start pulse which initiates a conversion.
3. Determines when conversion is complete and range pulses are not present.
4. Issues a print gate command to energize the Print Output Assemblies to the configuration of the front panel display.
5. Issues a print command to the external printer.

The inputs and outputs of the Print Control Assembly are listed in table 5-11.

The Print Control Assembly is enabled by a –12-volt READY command on terminal 51 combined with either

Table 5-11. Print Control Assembly Inputs and Outputs.

INPUT(S)	TERMINAL(S)	RECEIVED FROM ASSY.
$\overline{\text{PRINT FORCE}}$, $\overline{\text{PRINT HOLD}}$, $\overline{\text{PRINT AUTO}}$, $\overline{\text{TRACK}}$	11, 13, 15, 17	PRINT Switch or Remote No. 2
P20, CLOCK	37, 46	Program Control
FF DELAYED, $\overline{\text{FF}}$	31, 44	Remote No. 2 or FILTER Switch
ACD, KΩD, $\overline{\text{MV/DC}}$ ($\overline{\text{V/MV}}$) $\overline{\text{KΩ}}$, $\overline{\text{RATIO}}$	47, 49, 53, 55, 59	Remote No. 2 or FUNCTION Switch
DCD, MVD	35, 45	Display Driver No. 1
$\overline{\text{AUTORANGE}}$	9	RANGE Switch or Remote No. 1
$\overline{\text{DN}}$, $\overline{\text{UP}}$	57, 58	Decade Assembly
$\overline{\text{PR1}}$, $\overline{\text{PR2}}$, $\overline{\text{PR3}}$, $\overline{\text{PR4}}$, $\overline{\text{PR5}}$, $\overline{\text{RW2}}$	36, 38, 39, 40, 41, 34	Display Driver No. 2
$\overline{\text{READY}}$	51	Print Output No. 1
OUTPUT(S)	**TERMINAL(S)**	**DESTINATION ASSEMBLY(IES)**
CDC, DDC	33, 48	Display Driver No. 1
PR GATE	10	Print Output No. 1, 2, and 3
PR COMMAND	43	Print Output No. 1
$\overline{\text{PR START}}$	25	Program Control

the low signals on terminal 11 and 13 or the low signal on terminal 15. The print delay (settling time) is selected through terminals 31, 35, 45, 47, and 49. Terminals 9, 36, 38, 39, 40, 41, 53, 55, 57, and 59 are utilized to determine if range pulses are present.

When power is first applied to the instrument, Q1 and Q5 turn on and Q2, Q3, and Q4 stay off. The low signal at the collector of Q5 is inverted and applied to ZB4-1. When terminal 15 or terminals 11 and 13 are low ZB4-2 is held high by ZB1-11. Pin 5 of ZB4 is held high through terminal 17. Pin 4 of ZB4 goes high when ZA1 and ZA2 are reset. Flip-flops ZA1 and ZA2 are reset by applying a low pulse at terminal 51 which applied to the base of Q6 turns Q6 off and applies a high signal to the base of Q7 turning Q7 on. When Q7 conducts the low signal at the collector of Q7 is applied to a pulse generator and the low output resets ZA2. The high output on pin 9 of ZA2 is applied to pin 12 of ZA1 and, if ZA1 is in a set condition, will be reset with the next clock pulse. The high output of ZA1-9 triggers ZB4-6 and the low output is inverted and turns on Q2 which sets the multivibrator, consisting of Q4 and Q5, and the high output at the collector of Q5 turns off Q1 to enable the print delay potentiometers, and resets the flip-flop on ZB5. The high signal on the collector of Q5 is inverted and applied to ZB4-1. Capacitor C3 then starts charging through terminals 33 and 48, which are connected back to either terminal 31, 35, 45, 47, or 49 and associated print delay potentiometer by the FUNCTION or FILTER switch. When in full-filter or a converter function, terminal 34 is grounded and Q8 turns on, closes S1, and places C4 in parallel with C3. When the capacitors have charged to the trigger potential of the unijunction, Q3 fires discharging the capacitor through R17. The voltage drop across R17 resets the Q4-Q5 flip-flop to a low output at the collector of Q5. The low signal at the collector of Q5 causes ZB8 pulse generator to issue a low pulse to terminal 25 and P20 goes low. Pin 1 of ZB4 cannot go high until C6 has charged.

When the instrument has completed conversion, P20 comes high. If the instrument is in autorange mode with range change pulses present, however, the flip-flop in ZB5 sets, causing pin 13 of ZB6 to go low. This prevents print commands until ranging is completed. When C6 has charged positive, pin 1 of ZB4 goes high causing pin 6 of ZB4 to go low. Another print delay, $\overline{\text{PR START}}$

$\overline{\text{CONV}}$ command, and conversion are performed. This is repeated until range pulses are no longer present. When the range commands cease, allowing the flip-flop in ZB5 to remain reset, pin 12 of ZB6 is pulsed low, pin 8 of ZB4 goes low, and flip-flops ZA1 and ZA2 are set to a low output at pin 9. When ZA2 sets, a high PR GATE signal is provided through terminal 10 and a positive PR COMMAND pulse is applied through terminal 43.

When the HOLD switch is depressed, the Print Control Assembly is stopped until a print cycle is initiated by depressing the momentary contact FORCE switch. The HOLD switch grounds terminal 13 which enables the AND gate of ZB3. When the FORCE switch is depressed, terminal 11 is grounded which causes the flip-flop in ZB1 to set, in turn causing pin 11 of ZB1 to go high enabling a single print cycle. When ZA2 is reset by the $\overline{\text{READY}}$ command, the flip-flop in ZB1 is reset and the Print Control Assembly is stopped. Capacitor C13 provides a settling delay for the $\overline{\text{READY}}$ signal. If it is desired to operate at a faster rate, remove C13.

When the PRINT AUTO switch is depressed, pin 11 of ZB1 remains positive at all times. Therefore, when ZA1 is set by the $\overline{\text{READY}}$ command pin 4 of ZB4 goes positive and the Print Control Assembly starts another print cycle.

When the PRINT OFF switch is depressed, terminal 17 is grounded, disabling the Print Control Assembly and terminal 69 of the Program Control Assembly is grounded, allowing the instrument to operate under control of the rate oscillator.

1-2-4-8 PRINT OUTPUT ASSEMBLIES (Diagrams 16 through 23)

The 1-2-4-8 Print Output Assemblies provide outputs of range, function, polarity sign, overrange, out-of-range, and numeral indications in 1-2-4-8 BCD form and a print command to operate an external printer or data processing equipment. The assemblies also transfer the $\overline{\text{READY}}$ signal from the external equipment to the Print Control Assembly.

There are four options for the 1-2-4-8 BCD print output: +5 to 0 Diode Transistor Logic (DTL) voltage state, 0 to −12 voltage state, 0 to +12 voltage state, or isolated contact closure. Each option requires two assemblies.

The inputs common to all the BCD Print Output No. 1 and 2 Assemblies are listed in table 5-12. Discrete inputs

Table 5-12. BCD Print Output Assembly Inputs.

INPUT(S) NO. 1	TERMINAL(S)	RECEIVED FROM ASSY.
PRINT COMMAND	43	Print Control
$\overline{\text{RATIO}}$, $\overline{\text{K}\Omega}$, $\overline{\text{AC}}$, $\overline{\text{MV}}$	55, 51, 53, 49	FUNCTION Switch or Remote No. 2
+ SIGN	41	Reference Amplifier
$\overline{\text{PR1}}$, $\overline{\text{PR2}}$, $\overline{\text{PR3}}$, $\overline{\text{PR4}}$, $\overline{\text{PR5}}$, $\overline{\text{SIGN}}$ $\overline{\text{INHIBIT}}$, OR, OOR	27, 29, 31, 33, 35, 39, 25, 59	Display Driver No. 2
$\overline{\text{READY}}$	J2-1	External Printer
INPUT(S) NO. 2	**TERMINAL(S)**	**RECEIVED FROM ASSY.**
$\overline{\text{OR}}$	13	Print Output No. 1
D2 to D17	25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55	Decade

are described during the discussion of individual assemblies.

All outputs from the DTL Print Output No. 1 (diagram 16), through the rear panel connector J2, are +5 volts for a logic 1 and 0 volts for a logic 0. The maximum current output is 5 milliamperes. The RANGE input on terminal 27, 29, 31, 33, or 35 and FUNCTION input on terminal 49, 51, 53, or 55 are applied to OR-gates on ZA3 and ZA5 and the output is converted to the BCD code. When in the KΩ or AC function the high signals on terminals 39 and 41 are AND-gated and the output inverted providing a high output to disable the polarity sign. The OVERRANGE input is inverted by ZA5, and $\overline{\text{OVERRANGE}}$ is applied through terminal 13 to Print Output

No. 2 and No. 3, and inverted again by ZA4 and applied to J2-14. PRINT COMMAND, OOR and ESC input from a recorder are provided direct to J2. The P20 pulse on terminal 9 is applied to a pulse generator ZA1 and the output is applied to J2-29. The ESP pulse, from the external equipment, is applied through J2-28 to a pulse generator on ZA2. The output of ZA2 is inverted by ZA4-11 and applied through terminal 19 to the Program Control Assembly. The A-B jumper on the output of ZA4 is removed when using Remote Assemblies. The pulse generators, ZA1 and ZA2 also act as shaping circuits to ensure a uniform output pulse. The READY signal from the external equipment is connected through terminal 47 to the Print Control Assembly. The READY signal must be at 0 volts when the external equipment is receiving information and at −12 volts when the external equipment is not receiving, which enables the instrument to start another print cycle.

The DTL Print Output No. 2 Assembly (diagram 17) directly couples the 1-2-4-8 BCD numeral information on terminals 27, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, and P20 information on terminal 9 to the output connector J3. The $\overline{\text{OVERRANGE}}$ information is AND-gated with the 2- and 8-weighted bits of the 1K's decade information to disable the bits when $\overline{\text{OVERRANGE}}$ is high. If it is desired not to disable the 2- and 8-weighted bits during overrange the A-B jumper must be removed.

The 0 to −12 volt BCD Voltage State No. 1 and No. 2 Assemblies (diagrams 18 and 19) operate in a manner similar to the DTL Print Output Assemblies. All inputs except $\overline{\text{READY}}$, however, are enabled only when the PRINT GATE command on terminal 11 is high. The pulse generators, for the CONVERSION COMPLETE PULSE, and ESP, are not contained on the BCD Voltage State No. 1 Assembly, and the $\overline{\text{ESC}}$ and P20 pulses are not received by the BCD Voltage State Assemblies. The transistor-driven outputs are 0 volts for a logic 1 and −12 volts for a logic 0. The A-B jumper for preventing $\overline{\text{OVERRANGE}}$ from disabling the 2- and 8-weighted 1K bits is located on BCD Voltage State No. 1 Assembly.

The 0 to +12 volt BCD Voltage State No. 1 and No. 2 Assemblies (diagrams 20 and 21) operate in a manner similar to the 0 to −12 volt BCD Voltage State. Transistors Q11 and Q12 with their associated circuitry make up a voltage regulator with a +12 volt output. The transistor-driven outputs are 0 volts for a logic 1 and +12 volts for a logic 0.

The contact closure BCD Print Output No. 1 and No. 2 Assemblies (diagrams 22 and 23) also operate in a manner similar to the DTL Print Output Assemblies. The outputs, however, are transistor-driven reed relays which are closed for a logic 1 and open for a logic 0. The reed relays provide complete isolation of the instrument from the external printer. P20 is not received and there is no jumper for preventing the $\overline{\text{OVERRANGE}}$ from disabling the 2- and 8-weighted 1K bits. The $\overline{\text{READY}}$ signal, received from the printer at terminals J2-2 and J2-26, control an isolated reed relay on BCD Print Output No. 1 Assembly. The relay is closed to common for high and open for low. If the A-B jumper is moved to A-C and a D-E jumper installed, the $\overline{\text{READY}}$ signal is directly connected to the Print Control Assembly through terminals J2-1 and J2-48. If jumpers F-G, O-N, M-L, K-J, I-H, R-S, P-Q, and T-U on BCD Print Output No. 1 Assembly and jumpers A-B, C-D, E-F, G-H, J-K, and L-M on BCD Print Output No. 2 Assembly are removed, all functions can be driven separately for serial operation.

10-LINE PRINT OUTPUT ASSEMBLIES (Diagrams 24, 25 and 26)

The 10-Line Print Output Assemblies provide outputs of range, function, + and − polarity sign, overrange 1 and 0, in range and out of range, numeral indications in 10-line form and a print command to operate an associated external recording device. The assemblies also transfer the $\overline{\text{READY}}$ signal from the external equipment to the Print Control Assembly.

The 10-line print output option consists of three assemblies.

The inputs to the 10-Line Print Output Assemblies are the same as for the BCD Print Output No. 1 and No. 2 Assemblies with the following exceptions: $\overline{\text{READY}}$ signal is received at J2-49 and $\overline{\text{OR}}$ is received at 10-Line Print Output Assembly No. 3 on terminal 29. The added function of $\overline{\text{DC V}}$ is received on terminal 45 of the 10-Line Print Output No. 1 Assembly.

The inputs to the assemblies control transistor driven reed relays which are closed for a logic 1 and open for a logic 0. The reed relays provide complete isolation of the

instrument from the external printer. When in the KΩ or AC function the +SIGN is AND-gated with $\overline{\text{SIGN INHIBIT}}$ to disable the polarity sign. The overrange information is inverted and applied to 10-Line Print Output No. 3 Assembly through terminal 13. The $\overline{\text{READY}}$ signal, received from the printer at terminal J2-4 and J2-5, control an isolated reed relay. If the A-B jumper is moved to A-C and the D-E jumper moved to D-F the $\overline{\text{READY}}$ signal is directly connected to the Print Control Assembly through terminals J2-48 and J2-49. The $\overline{\text{READY}}$ signal must be at 0 volts when the printer is recording and at −12 volts when it is not recording to enable the instrument to start another print cycle. If jumpers G-H, R-S, P-Q, J-K, L-M, and N-O, on the 10-Line Print Output No. 1 Assembly and jumpers A-B and C-D on the 10-Line Print Output No. 2 and No. 3 Assemblies are removed the functions can be driven separately for serial operation.

REMOTE NO. 1 ASSEMBLY (Diagram 27)

The Remote No. 1 Assembly enables remote control of the conversion rate, reference selection, decimal point indication, and RANGE switches. It transfers the conversion complete pulse P20 to a remote location.

The inputs and outputs of the Remote No. 1 Assembly are listed in table 5-13.

To remotely control the conversion rate, terminals J5-10 and J5-41 must be grounded to terminal J5-47. The control signal through terminal 37 disables the rate oscillator on the Program Control Assembly. The start signal, generated each time terminal J5-41 is unclamped, is applied to a pulse generator on ZA7, AND-gated with the output of ZA9-11 and applied to terminal 31. The frequency of the externally controlled start pulse must not exceed 1 KHz and the amplitude must not exceed +5 volts. The pulse width must be between 100 microseconds and 700 microseconds. When an up range pulse is received at terminal 53 during autoranging the flip-flop on ZA9 is set and the low output of ZA9-11 disables the external start signal. The flip-flop will remain set until C1 charges and then reset.

When the front panel REMOTE switch is depressed terminal 11 goes low, is inverted by ZB1-6, and enables remote control of reference selection, decimal point indications, and RANGE switch.

Table 5-13. Remote No. 1 Assembly Inputs and Outputs.

INPUT(S)	TERMINAL(S)	RECEIVED FROM ASSY.
$\overline{\text{UP}}$	53	Decade
P20	33	Program Control
$\overline{\text{RW2}}$, $\overline{\text{RW1}}$	45, 47	Display Driver No. 2
$\overline{\text{RGE REM COM}}$	11	RANGE Switch
OUTPUT(S)	**TERMINAL(S)**	**DESTINATION ASSEMBLY(IES)**
$\overline{\text{EXT START}}$	37	Program Control
$\overline{\text{CONT}}$, EXT START PULSE	31	
$\overline{\text{EXT REF SELECT}}$	49	Reference Amplifier, Display Driver No. 1
$\overline{\text{REMOTE DEC CONTROL}}$, $\overline{\text{RD1}}$, $\overline{\text{RD2}}$, $\overline{\text{RD3}}$, $\overline{\text{RD4}}$, $\overline{\text{RD5}}$, $\overline{\text{MR1}}$, $\overline{\text{MR2}}$, $\overline{\text{MR3}}$, $\overline{\text{MR4}}$, $\overline{\text{MR5}}$, $\overline{\text{MR6}}$	43, 55, 23, 21, 19, 17, 41, 39, 35, 29, 27, 25	Display Driver No. 2
$\overline{\text{AUTORANGE}}$	9	Print Control, Autorange

The external reference is selected by grounding terminal J5-12 to terminal J5-47, inverted, AND-gated with the REMOTE function and applied to terminal 49. When external reference is selected, external control of the decimal point is required. To externally control the decimal point, terminal J5-25 must be grounded to terminal J5-47 to disable the internal decimal. The signal on J5-25 is inverted, AND-gated with the REMOTE function, and applied to terminal 43. The low output of ZB2-3 is also inverted and enables the AND-gates to allow

Z2-2 and 4 set the flip-flop on Z2. The output goes high and is applied to pin 18 of Z1. The analog value is received at terminal AMP 1 from the Input Amplifier Subassembly and applied to Z1-4. The output of Z1-28 is applied to the Input Amplifier Subassembly and Reference Amplifier Assembly through TJ1-TJ2 jumper and terminal S/H OUT. At the end of the conversion process terminal P20 goes high, is inverted, and resets the flip-flop on Z2. The DC OFFSET ADJ adjusts the DMM for zero indication when the input leads are shorted. The S/H OFFSET ADJ is a factory adjustment. To bypass the Sample and Hold Assembly connect the jumper between TJ2 and TJ3.

The Sample and Hold Module (figure 5-6) consists of an input amplifier, switch, memory capacitor, and output amplifier. The analog signal is connected between the INPUT (pin 4) and GROUND (pin 7). During the sample mode the output tracks the input. When a trigger pulse is applied to S/H TRIGGER INPUT (pin 18) the switch driver opens S1 and closes S2 which places the unit in the hold mode. When S1 opens the module stores the analog value within an aperture time of less than 50 nanoseconds. Typical aperture time is 30 to 50 nanoseconds. A typical Sample and Hold delay, from the input trigger 50-percent-point to the start of switch opening, is 46 to 49 nanoseconds. The analog value of the input signal is stored by capacitor C1. The output of the output amplifier is applied to pin 28.

Figure 5-7 shows a typical timing sequence. When a SP is received, after a delay of 80 nanoseconds if the ESP

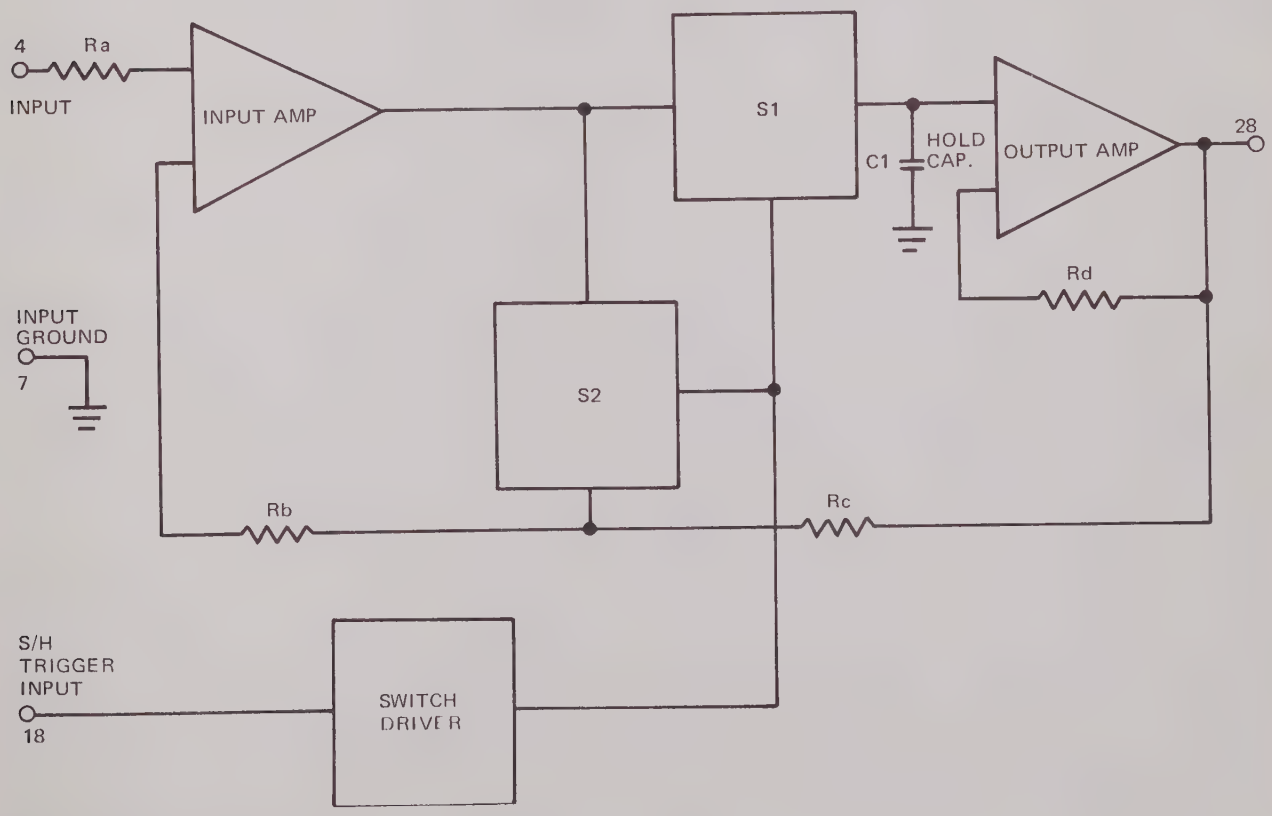


Figure 5-6. Sample and Hold Module Block Diagram.

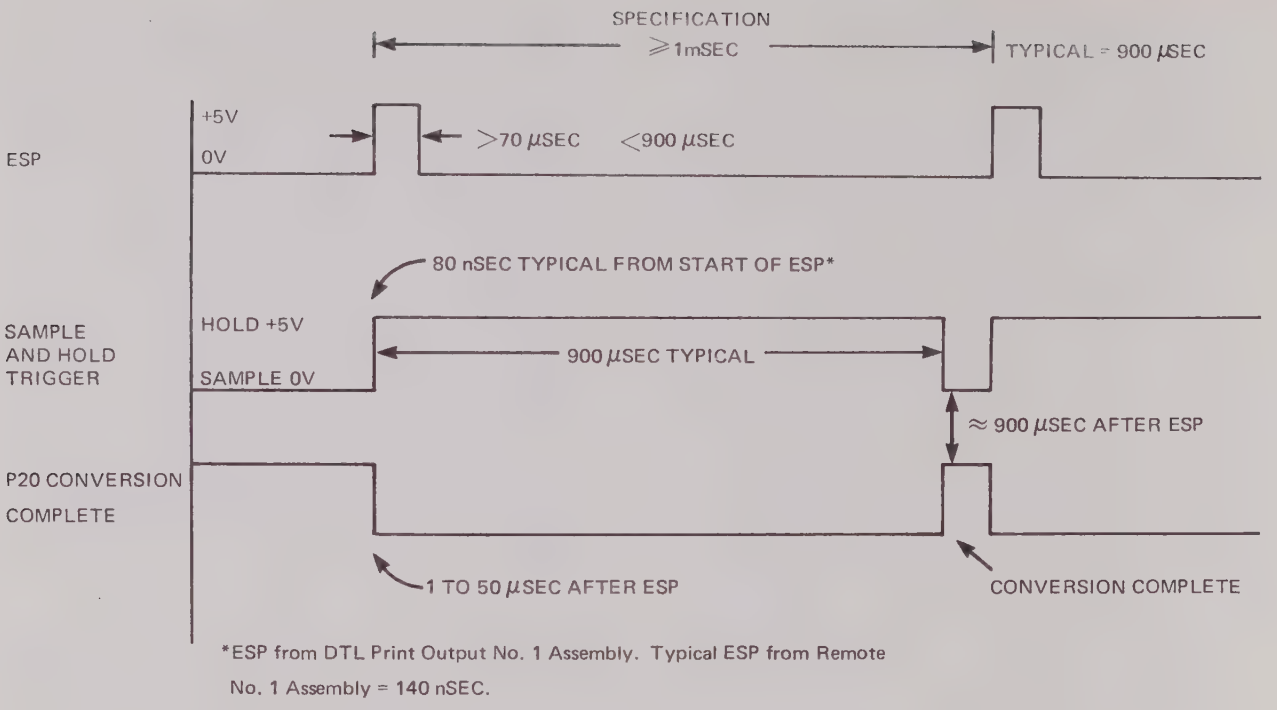


Figure 5-7. Sample and Hold Timing at 1 KHz Clock Rate.

is initiated by an external recorder or 140 nanoseconds if initiated by a remote control unit, the Sample and Hold Assembly starts to change from sample mode to hold mode. At this time there is a 40 to 50 nanosecond delay to the start of switch opening. At a time between 30 to 50 nanoseconds, after switch opening, there will be an uncertainty delay of 20 nanoseconds until the Sample and Hold Module is in hold. The ESP also starts the DVM conversion coincident with the next clock pulse. At the end of the conversion, P20 time, the Sample and Hold Module is switched to sample. Therefore, the Sample and Hold Module is always sampling except during DVM conversion.

For installation instructions and operating characteristics refer to Section VI.

MASTER SCHEMATIC DIAGRAM (Diagram 32)

The master schematic diagram shows the interconnections between the external connectors, individual assemblies, front panel switches, and the master circuit board.

INTERFACING

The Model 6653A, with optional equipment installed, can be programmed from a remote location and can provide printout information to associated recording devices.

REMOTE PROGRAMMING

Remote programming can be accomplished through either:

1. A set of Remote Assemblies installed in the Model 6653A that provide no isolation between the instrument and a remote control unit.

2. A set of Remote Buffer Assemblies that provide isolation between the instrument and the remote unit by means of contact closures. The customer must furnish −12 VDC to operate the isolation relays.

PRINT OUTPUT

Print output information is available either in voltage-state form or by means of contact closures. The information can be provided as 10 line decimal (contact closure only) or 1-2-4-8 BCD output.

The instrument can be operated in one of two print modes. In Print Mode 1 no printout delays are provided and maximum printing speed results. For Mode 1, the External Start Pulse and DTL Print Output Assemblies are used. In Print Mode 2, the normal mode, the Print Control Assembly and either the 10-Line, or 1-2-4-8 BCD Print Output Assemblies are required.

In Print Mode 1 (figure 5-8), when $\overline{\text{EXT START CONT}}$ is programmed from the external recorder the instrument will lock up. With each EXT START PULSE from the external recorder, the instrument will take a single reading and then lock up. P20/Conversion Complete is the print command. If the instrument is in AUTO-RANGE, an External Start Pulse is required for each range change.

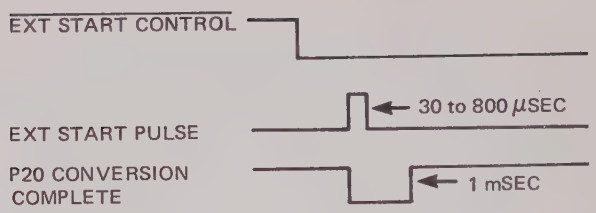


Figure 5-8. Print Mode 1 Operation.

In Print Mode 2 the print timing sequence is controlled by the Print Control Assembly. Figure 5-9 shows the sequence of events for single print operation.

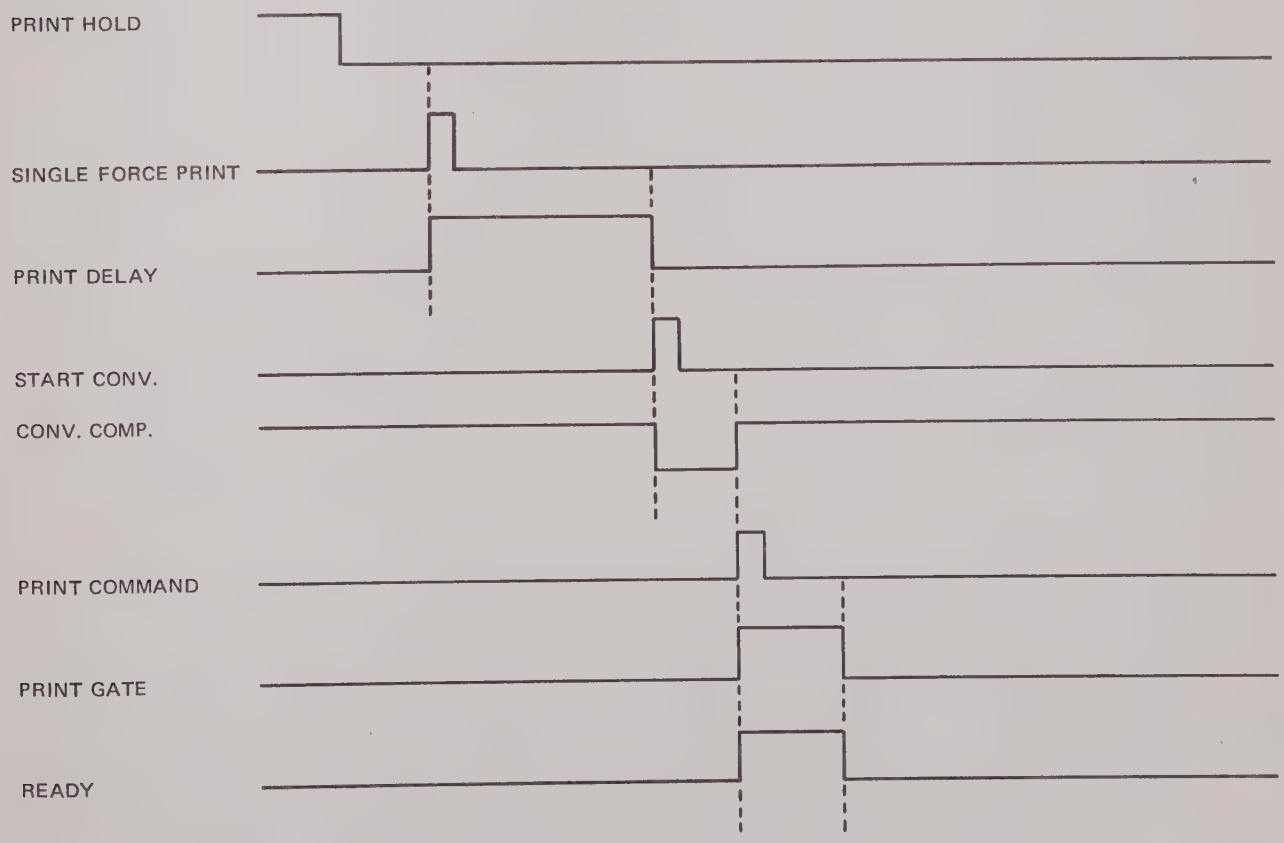


Figure 5-9. Print Mode 2, Single Print.

First, Print Hold and then Force Print Commands are programmed from the remote control unit. The Force Print Command starts a 3-phase print operation. During phase one the Print Control Assembly generates a Print Delay Command to allow the instrument to settle. At the end of the delay period, which is adjustable for DC V, AC, KΩ, or MV modes of operation and FILTER FULL operation; phase two commences. In phase two the Print Control Assembly issues Start Conversion and Conversion Complete commands. The commands enable the instrument to take a single measurement and then lock up. Phase three, the print phase, then starts. The Print Control Assembly generates Print Command and Print Gate signals. The Print Command enables the associated recording device to print. The Print Gate signal closes the instrument print output reeds, making the printout information available to the recording device. The Ready signal is generated by the recording device upon completion of the recording device print cycle. The Ready signal resets the Model 6653A. Until the Ready signal is received, no further measurements can be made.

In Print Mode 2 with AUTO PRINT, the 3-phase print operation is repetitive (figure 5-10).

The READY signal (6) from the associated recording device provides the SINGLE PRINT PULSE (1) that initiates the delay (instrument settling) phase. The delay time can be adjusted between minimum and maximum values as follows:

MODE OF OPERATION	MIN. TIME	MAX. TIME
DC V	50 MSEC	400 MSEC
MV, AC, KΩ	100 MSEC	800 MSEC
FILTER FULL	100 MSEC	3 SEC

The minimum delay times are dictated by the instrument's requirements to properly function when in autoranging and medium filter.

The DELAY COMPLETE (2) results in START CONVERSION (3). In the conversion phase, the time from START CONVERSION to CONVERSION COMPLETE (4) is 1 millisecond. Providing range change pulses are not present at the Print Control Assembly, when conversion has been completed the Print Control initiates a PRINT COMMAND (5) to the associated recording device. In the print phase, the elapsed time between PRINT COMMAND and READY signal (6) is variable and depends on the characteristics of the recording device.

When range change pulses are present at the Print Control Assembly during CONVERSION COMPLETE (4), the Print Control will not issue a PRINT COMMAND. It will issue, instead, a SINGLE PRINT PULSE that restarts the delay phase.

When the instrument is in AUTORANGE one SINGLE PRINT PULSE will suffice regardless of the number of range changes.

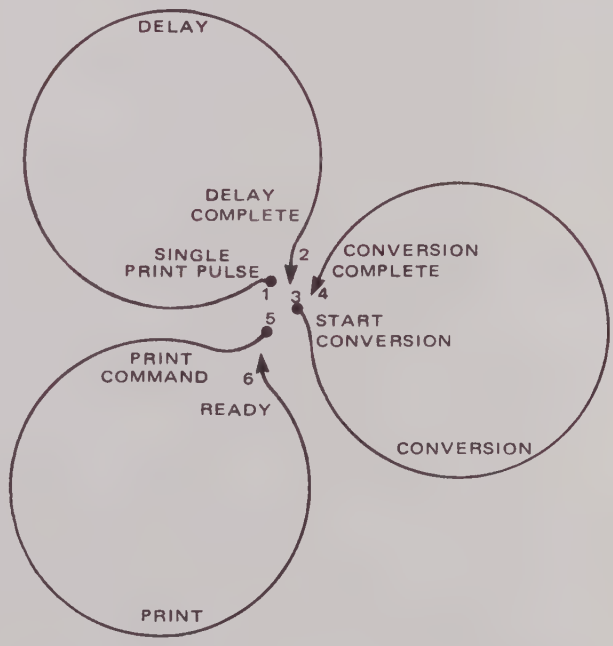


Figure 5-10. Print Mode 2, With Auto Print.

SECTION VI
MAINTENANCE

GENERAL

Section VI contains troubleshooting information, installation instructions for optional equipment ordered separately, parts lists, parts location diagrams, and schematic or logic diagrams of each assembly.

TROUBLESHOOTING AND REPAIR

With a set of spare assemblies, or a second properly-operating instrument from which assemblies can be borrowed, troubleshooting the instrument is extremely simple. Since the majority of components are mounted on plug-in circuit board assemblies, troubleshooting is reduced to replacing existing assemblies with spare assemblies until the defect is remedied. Instrument down time is reduced to a very few minutes.

WARNING

To avoid injury to personnel or damage to the instrument, power must be off when removing or inserting plug-in assemblies.

When removing an assembly, always use the wire board puller which is located in a mounting bracket under the top shield. Insert the board puller from the component side of the assembly and pull straight out. When inserting an assembly, lower it gently until the connectors are seated and then push it into place. To remove the Display Driver No. 1 Assembly, remove the two small side panels and remove the top screw and small bracket under each side panel. Lift off the top front trim strip and remove the Display Driver No. 1 Assembly with the board puller.

Faulty assemblies can be returned to Cimron (or a Cimron representative) for repair. If it is decided to repair an assembly locally, however, parts lists and diagrams are provided in this section as an aid.

Replacement or repair of the Input Amplifier and Decoder Subassemblies or Reference Amplifier Assembly requires recalibration of the instrument (Section IV).

When fuse resistor F1 of the MV/Ohms Converter is replaced, the assembly must be recalibrated (Section IV).

CAUTION

When replacing components on an assembly, care should be taken to prevent damage to the component from excessive heat. A low wattage soldering iron is recommended for soldering operations on the assembly. Whenever practicable, a heat sink should be used between the soldering point and the component body.

Standard electronics parts used in the instrument may be obtained locally. It is recommended, however, that precision components and mechanical parts be ordered from a Cimron representative or direct from the factory.

As the Model 6653A is a closed loop instrument, a point to keep in mind while troubleshooting the instrument is that an overrange lock-up condition is normally due to an open loop while a 0.000 lock-up is normally due to a shorted loop.

DECODER/INPUT AMPLIFIER ASSEMBLY REPAIR

The Decoder/Input Amplifier Assembly is comprised of the Decoder Subassembly, Input Amplifier Subassembly and Resistor Set 66-0511-1.

The resistor set consists of R1 through R20 on the Decoder Subassembly and R21 and R22 on the Input Amplifier Subassembly. The resistors are ratio-matched and must be replaced as a set. If any of the resistors must be replaced, return the Decoder and Input Amplifier Subassemblies to the factory for service.

The comparator section of the Input Amplifier Subassembly may, if required, be repaired in the field. If any parts are replaced in the comparator, rezeroing of integrated-circuit amplifier A2 and calibration of the instrument is required. To rezero A2, unsolder the Decoder Input end of the jumper shown at terminal A above R26 on diagram 5 and resolder it to terminal C of R26. Attach a five-digit DVM from TP4 to signal common. Adjust R40 for a minimum reading at TP4. Resolder the jumper to its original position at terminal A. Calibrate the instrument in accordance with Section IV of this manual.

If a Decoder Subassembly switch is suspected of being faulty, the following procedure is recommended.

1. Remove top and bottom covers and shields and turn instrument on its side.

2. Depress FUNCTION DC V and HOLD switches and allow instrument to warmup for at least 30 minutes.

3. Connect the COMMON lead of a 5-digit DVM to SIGNAL COMMON and attach the signal lead to the input side (switch side) of resistor R1 on the Decoder Subassembly. If the 5-digit DVM indication is greater than ±0.0005V, the transistor switch is faulty. Repeat the procedure for resistors R2, R3, and R4.

4. Repeat step 3 for resistors R6 through R9, R11 through R14, and R16 through R19, except the DVM should indicate ±0.005V or less.

5. Attach one end of a clip lead to ANA COM on bottom of Master Assembly and momentarily touch the other end to $\overline{\text{P03}}$ on bottom of Decade Assembly. Attach the DVM signal lead again to R1 on the Decoder Subassembly. The reading should be 11.000 volts.

6. Momentarily touch clip lead to $\overline{\text{P01}}$ on the Decade Assembly (to reset switch) and then touch $\overline{\text{P04}}$ to set next switch. Move DVM signal lead to R2 on the Decoder Assembly and check for 11.000 volts. Repeat for $\overline{\text{P05}}$-R3 and $\overline{\text{P06}}$-R4.

7. The procedure for the 100's, 10's, and units switches is the same except that the DMM 11.000 volts indication may be ±5 millivolts.

REFERENCE AMPLIFIER ASSEMBLY REPAIR

Zener diodes CR1, CR2, and CR3 and resistor R1 of the Reference Amplifier must be replaced as a set. If any of these parts must be replaced, return the Reference Amplifier to the factory for service.

If any parts are replaced in the negative amplifier section of the Reference Amplifier Assembly, the negative amplifier A1 requires rezeroing. To rezero amplifier A1, unsolder the R29 termination of the jumper between R29 and CR10 on diagram 9 and resolder it to R33. Attach a five-digit DVM from output of A1 to signal common. Adjust R39 for a zero at the output of A1. Resolder the jumper to its original R29 termination and recalibrate the instrument in accordance with Section IV.

OPTIONAL ACCESSORIES INSTALLATION INSTRUCTIONS

CONVERTERS, AUTORANGE, PRINT AND REMOTE ASSEMBLIES

If the Model 6653A is purchased without all of the optional accessories, additional accessory(ies) can be ordered separately and installed by the customer at a later date. To install the AC Converter, MV/Ohms Converter, Autorange, Print Control, Print Output, and Remote Control Assemblies, plug them into the slot provided for them in the instrument. The mounting hardware such as bench stand, rack-mounting brackets, or slide rails must be bolted on the instrument in the places provided for them.

REAR INPUT CONNECTOR

To install the optional rear panel signal INPUT connector:

1. Remove the top and bottom covers and shields.
2. Remove the chrome-plated press-in plug from the opening on the rear panel.
3. Secure the connector in place with the hardware provided.
4. Wire to the bottom of the master board as shown in figure 6-1.

INPUT SELECTOR ASSEMBLY

When a Model 6653A is purchased without the Input Selector Assembly, a two-conductor, guarded cable is installed in its place. If the Input Selector Assembly is purchased later, the cable must be removed before the Input Selector can be installed.

To remove the cable:

1. Remove the bottom cover and bottom shield.
2. Observe that the INPUT SELECTOR terminals are clearly labeled on the Master Circuit Board.
3. Remove the end of the cable which is connected to terminals IN HI, IN LO, and GD.
4. Remove the end of the cable which is connected to terminals OUT HI, OUT LO, and GD.

SAMPLE AND HOLD ASSEMBLY

When a Model 6653A is purchased without a Sample and Hold Assembly and the assembly is purchased later, it can be connected in either of two electrical configurations:

1. Between the output of the Ranging Amplifier and R21 on the Input Amplifier Subassembly.
2. Between the Input Selector Assembly and the Ranging Amplifier.

Method 1 is used when the Sample and Hold Assembly is installed at the factory.

To install the assembly using method 1:

1. Remove the top cover and shield.
2. Remove Input Amplifier Subassembly and remove the F-G jumper. Ensure D-E jumper is removed.
3. Replace Input Amplifier Subassembly.
4. On Sample and Hold Assembly ensure that jumper is installed between TJ1 and TJ2.
5. Install Sample and Hold Assembly in slot provided in instrument.
6. Replace shield and top cover.

This placement allows for input protection, ranging, and high input resistance (refer to Signal Input Resistance specification for the basic instrument in Section II). This will give the following typical settling times for a 10V step:

0.01% in 300 μsec 0.1% in 250 μsec

By installing the D-E jumper on the Input Amplifier Subassembly the response time will decrease at the expense of the ranging ability. Typical response times, with jumpers installed, are:

0.01% = 100 μsec 0.1% = 50 μsec

Input protection up to 50 milliamps maximum at ±12 volts is in effect. A typical value of input capacity is:

Front input connections–95 pF
Rear input connections–140 pF

To install the assembly using method 2:

1. Remove top and bottom covers and shields.
2. Remove Input Amplifier Subassembly and remove F-G and G-H jumpers.
3. On the Master Circuit Board remove cable from Input Amplifier Subassembly pins INPUT, SIG COM, and SHIELD and reconnect to pins AMP 1, SIG COM, and SHIELD for the Sample and Hold Assembly.
4. Replace Input Amplifier Subassembly.

5. On Sample and Hold Assembly ensure that jumper is installed between TJ1 and TJ2. Install assembly in instrument.

6. Replace shield and top and bottom covers. This configuration allows for the shortest settling time. For a 10-volt step the maximum settling time is 0.01% in 7 μsec. Typical is 0.01% in 5 μsec. The maximum rate of change to obtain a 0.01% reading is 0.04V/μsec.

   Typical Input Impedance

   100 MΩ shunted by 100 pF for front input connections.

   100 MΩ shunted by 140 pF for rear input connections.

Sample and Hold Assembly receiving ESP through DTL Print Output No. 1 Assembly.

Total delay specification 130 nsec min.–200 nsec max.
Total delay typical 154 nsec min.–181 nsec max.

Sample and Hold Assembly receiving ESP through Remote No. 1:

Total delay specification 180 nsec min.–260 nsec max.
Total delay typical 206 nsec min.–249 nsec max.

For very critical applications the delay time between the ESP and the Sample and Hold Module can be measured to eliminate the uncertainty between production units.

PARTS LISTS, PARTS LOCATION DIAGRAMS, AND SCHEMATIC DIAGRAMS

The parts location diagrams and schematic or logic diagrams of each plug-in assembly are located immediately after the parts lists for ready reference.

Parts lists and diagrams are provided for five different print output options and two different remote control options. Only one print output option and one remote control option can be installed at one time in the instrument.

The applicable specifications of diodes manufactured specially for Cimron are as follows:

CD-61, I_f = 1V greater than 100 ma,
I_r = 75V less than 1 ua, SILICON

CD-62, I_f = 1V greater than 100 ma,
I_r = 250V less than 6 ua, SILICON

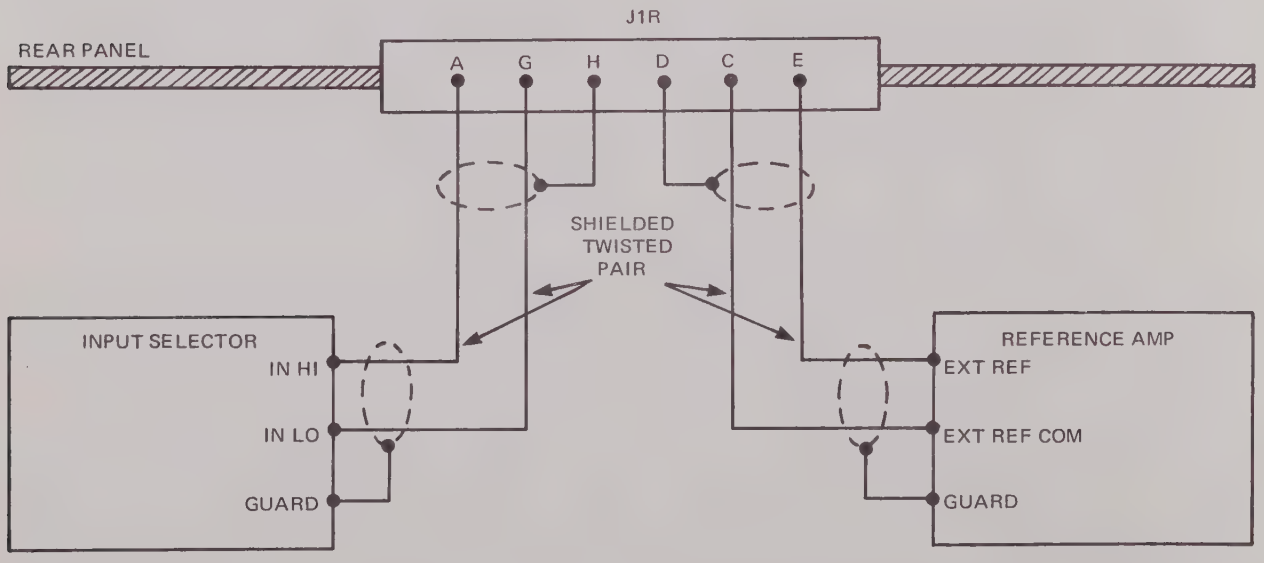


Figure 6-1. Rear Panel Input Connector Wiring.

REAR INPUT CONNECTOR

To install the optional rear panel signal INPUT connector:

1. Remove the top and bottom covers and shields.
2. Remove the chrome-plated press-in plug from the opening on the rear panel.
3. Secure the connector in place with the hardware provided.
4. Wire to the bottom of the master board as shown in figure 6-1.

INPUT SELECTOR ASSEMBLY

When a Model 6653A is purchased without the Input Selector Assembly, a two-conductor, guarded cable is installed in its place. If the Input Selector Assembly is purchased later, the cable must be removed before the Input Selector can be installed.

To remove the cable:

1. Remove the bottom cover and bottom shield.
2. Observe that the INPUT SELECTOR terminals are clearly labeled on the Master Circuit Board.
3. Remove the end of the cable which is connected to terminals IN HI, IN LO, and GD.
4. Remove the end of the cable which is connected to terminals OUT HI, OUT LO, and GD.

SAMPLE AND HOLD ASSEMBLY

When a Model 6653A is purchased without a Sample and Hold Assembly and the assembly is purchased later, it can be connected in either of two electrical configurations:

1. Between the output of the Ranging Amplifier and R21 on the Input Amplifier Subassembly.
2. Between the Input Selector Assembly and the Ranging Amplifier.

Method 1 is used when the Sample and Hold Assembly is installed at the factory.

To install the assembly using method 1:

1. Remove the top cover and shield.
2. Remove Input Amplifier Subassembly and remove the F-G jumper. Ensure D-E jumper is removed.
3. Replace Input Amplifier Subassembly.
4. On Sample and Hold Assembly ensure that jumper is installed between TJ1 and TJ2.
5. Install Sample and Hold Assembly in slot provided in instrument.
6. Replace shield and top cover.

This placement allows for input protection, ranging, and high input resistance (refer to Signal Input Resistance specification for the basic instrument in Section II). This will give the following typical settling times for a 10V step:

0.01% in 300 μsec 0.1% in 250 μsec

By installing the D-E jumper on the Input Amplifier Subassembly the response time will decrease at the expense of the ranging ability. Typical response times, with jumpers installed, are:

0.01% = 100 μsec 0.1% = 50 μsec

Input protection up to 50 milliamps maximum at ±12 volts is in effect. A typical value of input capacity is:

Front input connections–95 pF
Rear input connections–140 pF

To install the assembly using method 2:

1. Remove top and bottom covers and shields.
2. Remove Input Amplifier Subassembly and remove F-G and G-H jumpers.
3. On the Master Circuit Board remove cable from Input Amplifier Subassembly pins INPUT, SIG COM, and SHIELD and reconnect to pins AMP 1, SIG COM, and SHIELD for the Sample and Hold Assembly.
4. Replace Input Amplifier Subassembly.

5. On Sample and Hold Assembly ensure that jumper is installed between TJ1 and TJ2. Install assembly in instrument.

6. Replace shield and top and bottom covers. This configuration allows for the shortest settling time. For a 10-volt step the maximum settling time is 0.01% in 7 μsec. Typical is 0.01% in 5 μsec. The maximum rate of change to obtain a 0.01% reading is 0.04V/μsec.

   Typical Input Impedance

   100 MΩ shunted by 100 pF for front input connections.

   100 MΩ shunted by 140 pF for rear input connections.

Sample and Hold Assembly receiving ESP through DTL Print Output No. 1 Assembly.

Total delay specification 130 nsec min.–200 nsec max.
Total delay typical 154 nsec min.–181 nsec max.

Sample and Hold Assembly receiving ESP through Remote No. 1:

Total delay specification 180 nsec min.–260 nsec max.
Total delay typical 206 nsec min.–249 nsec max.

For very critical applications the delay time between the ESP and the Sample and Hold Module can be measured to eliminate the uncertainty between production units.

PARTS LISTS, PARTS LOCATION DIAGRAMS, AND SCHEMATIC DIAGRAMS

The parts location diagrams and schematic or logic diagrams of each plug-in assembly are located immediately after the parts lists for ready reference.

Parts lists and diagrams are provided for five different print output options and two different remote control options. Only one print output option and one remote control option can be installed at one time in the instrument.

The applicable specifications of diodes manufactured specially for Cimron are as follows:

CD-61, I_f = 1V greater than 100 ma,
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CD-62, I_f = 1V greater than 100 ma,
I_r = 250V less than 6 ua, SILICON

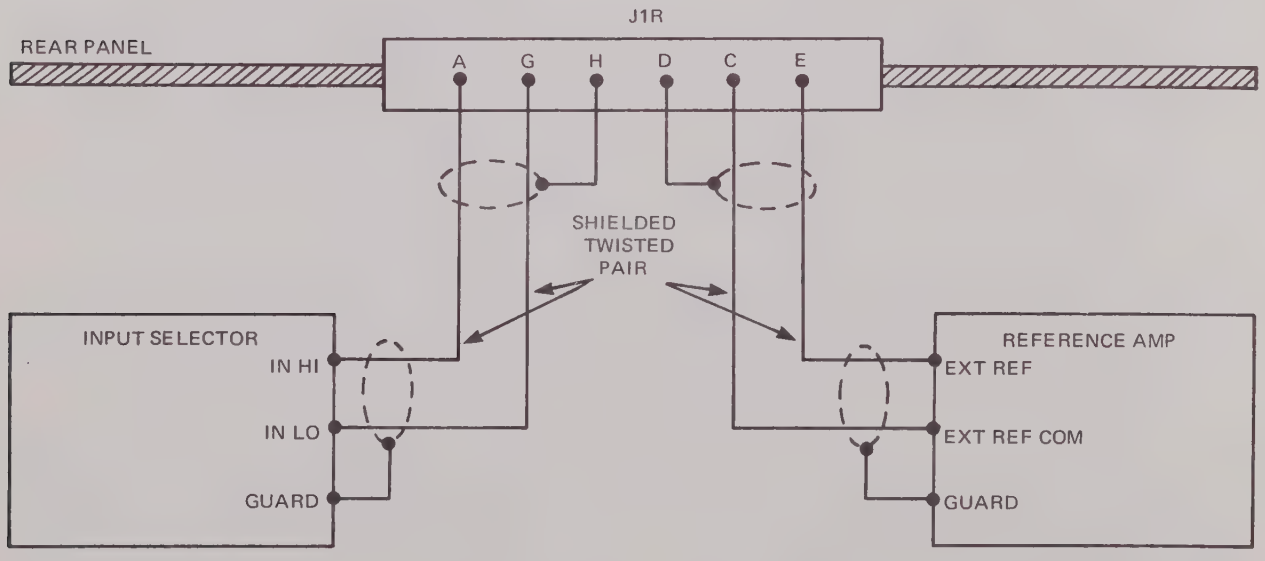


Figure 6-1. Rear Panel Input Connector Wiring.

POWER SUPPLY & FILTER

ASSEMBLY 66-6078

PARTS LIST

ASSEMBLY: Power Supplies & Filter **SCHEMATIC NO.:** 66-0778 **PART NO.:** 66-6078

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A9)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7078-3		15318
2	26	CONTACT–ELECT		2-63904	5001-1923	91662
3	1	CAP ELECT 100 25V	C3	1-57253	TE-1211	56289
4	2	CAP ELECT 2200 25V	C9,C10	1-57273	39D228G025-HP4	56289
5	2	CAP ELECT 500 50V	C1,C8	1-57274	39D507G050-GL4	56289
6	2	CAP ELECT 50 50V	C6,C7	1-57257	TE-1307	56289
7	1	CAP SIL MICA 100 PF	C4	1-57469	CM15E101J	04062
8	1	CAP SIL MICA 200 PF	C5	1-57474	CM15E201J	04062
9	1	TEST POINT JACK–RED	TP2	5-19002	TJ-51-2	82042
10	1	TEST POINT JACK–BROWN	TP1	5-19004	TJ-51-4	82042
11	1	TEST POINT JACK–GREEN	TP5	5-19005	TJ-51-5	82042
12	1	TEST POINT JACK–ORANGE	TP3	5-19006	TJ-51-6	82042
13	1	TEST POINT JACK–BLUE	TP6	5-19007	TJ-51-7	82042
14	1	TEST POINT JACK–YELLOW	TP4	5-19008	TJ-51-8	82042
15	1	TEST POINT JACK–VIOLET	TP7	5-19010	TJ-51-10	82042
16	2	RES COMP 1/2W 5% 100	R3,R22	7-41031	RC20GF101J	MIL-R-11
17	1	RES COMP 1/2W 5% 3.9K	R13	7-41050	RC20GF392J	MIL-R-11
18	1	RES COMP 22	R10	7-41223	RC07GF220J	MIL-R-11
19	1	RES COMP 2.2K	R21	7-41247	RC07GF222J	MIL-R-11
20	1	RES COMP 8.2K	R5	7-41254	RC07GF822J	MIL-R-11
21	2	RES COMP 10K	R18,R20	7-41255	RC07GF103J	MIL-R-11
22	1	RES COMP 15K	R1	7-41257	RC07GF153J	MIL-R-11
23	2	RES COMP 47K	R4,R12	7-41263	RC07GF473J	MIL-R-11
24	1	RES TIN OXIDE 3.32K 1%	R9	7-46704	RN60D3321F	07716
25	2	RES TIN OXIDE 6.81K 1%	R6,R19	7-46715	RN60D6811F	07716
26	1	RES TIN OXIDE 100K 1%	R11	7-46716	RN60D1003F	07716
27	1	RES TIN OXIDE 1.82K 1%	R8	7-46731	NA60	07716
28	3	RES TIN OXIDE 3.92K 1%	R7,R16,R17	7-46753	RN60D3921F	07716
29	1	RES TIN OXIDE 11K 1%	R14	7-46754	RN60D1102F	07716
30	1	RES TIN OXIDE 562 1%	R2	7-46776	RN60D5620F	07716

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

ASSEMBLY: Power Supplies & Filter **SCHEMATIC NO.:** 66-0778 **PART NO.:** 66-6078

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A9)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
31	1	RES TIN OXIDE 14.7K 1%	R15	7-46803	NC5	07115
32	1	SEMICOND DIODE	CR14	7-95516	MDA920A-6	15873
33	5	SEMICOND DIODE	CR2-CR6	7-95647	1N914	JEDEC
34	1	SEMICOND ZENER	CR7	7-95658	1N4740A	JEDEC
35	5	SEMICOND DIODE	CR8,CR10-CR13	7-95659	MR1030B	15873
36	2	SEMICOND DIODE	CR1,CR9	7-95660	MDA920A-2	15873
37	6	TRANSISTOR	Q2-Q6,Q9	9-04003	2N2222	JEDEC
38	2	TRANSISTOR	Q7,Q8	9-04007	2N2920	JEDEC
39	1	TRANSISTOR	Q1	9-04004	2N2907	JEDEC
40	1	RES COMP 1/2W 22	R23	7-41023	RC20GF220J	MIL-R-11
41	1	CAP CER DISC 0.01 50V	C11	1-57513	CK103	71590
42	1	CAP ELECT 4000 15V	C2	1-59010	39D408G0-15VL4	56289

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

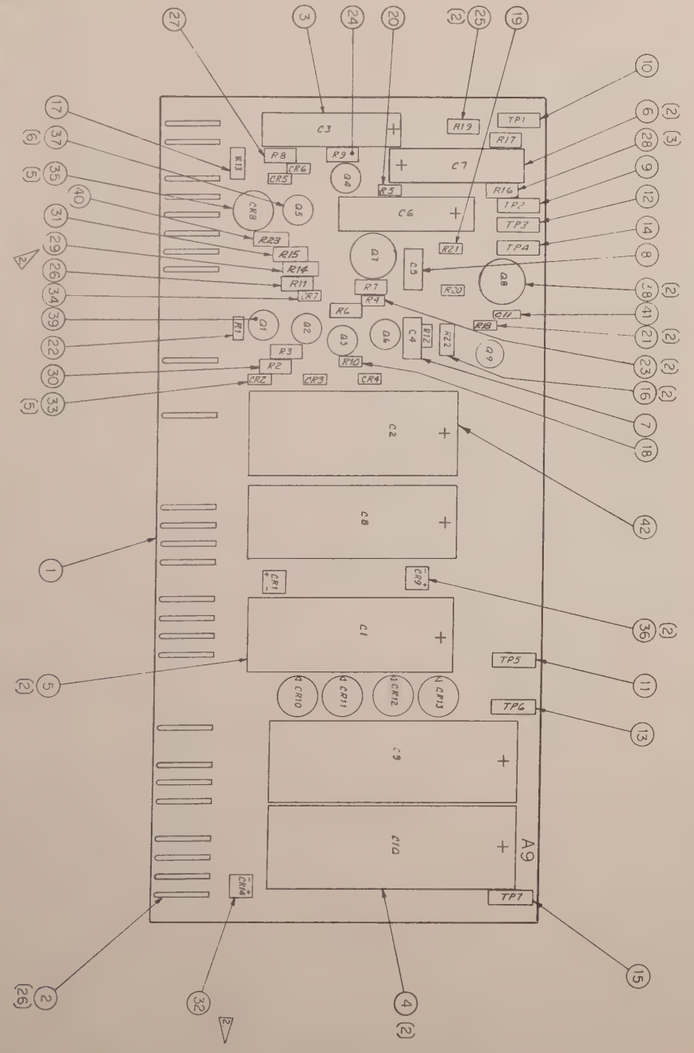


Figure 6-2. Power Supply and Filter Assembly.

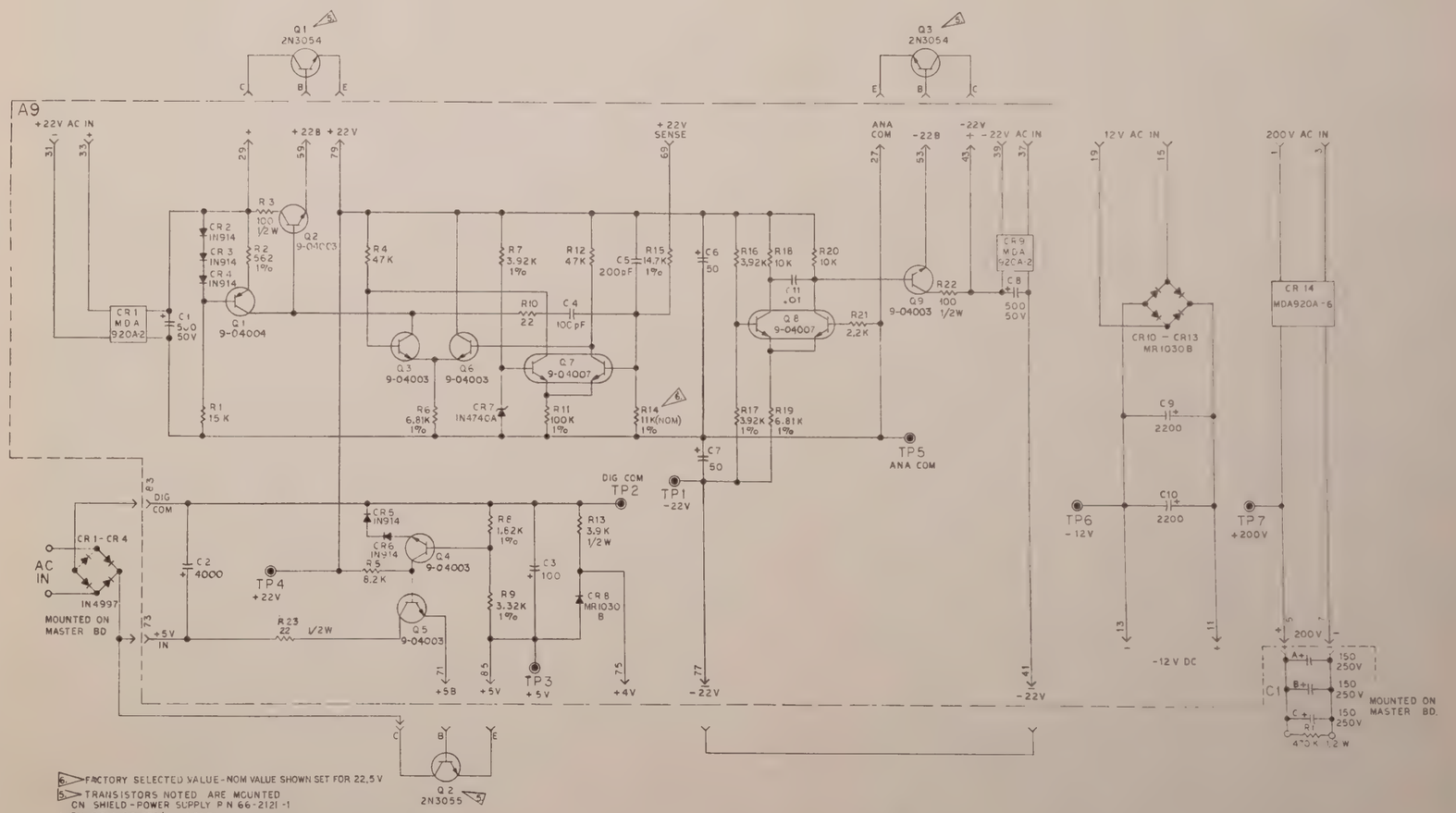


Diagram 1. Power Supply and Filter Schematic.

INPUT SELECTOR

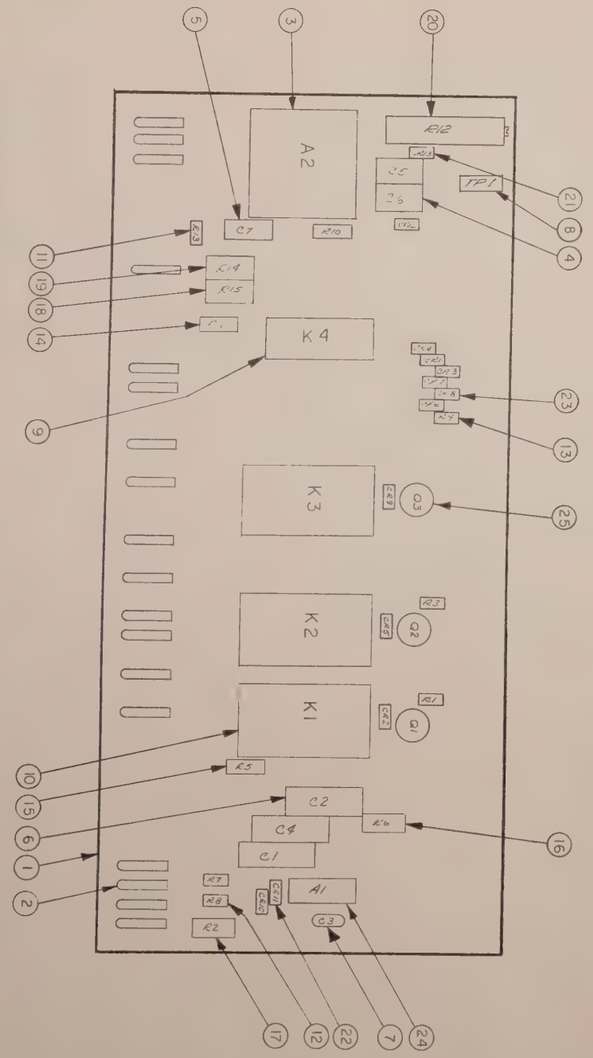
ASSEMBLY 66-6117

PARTS LIST

ASSEMBLY: Input Selector **SCHEMATIC NO.:** 66-0817 **PART NO.:** 66-6117

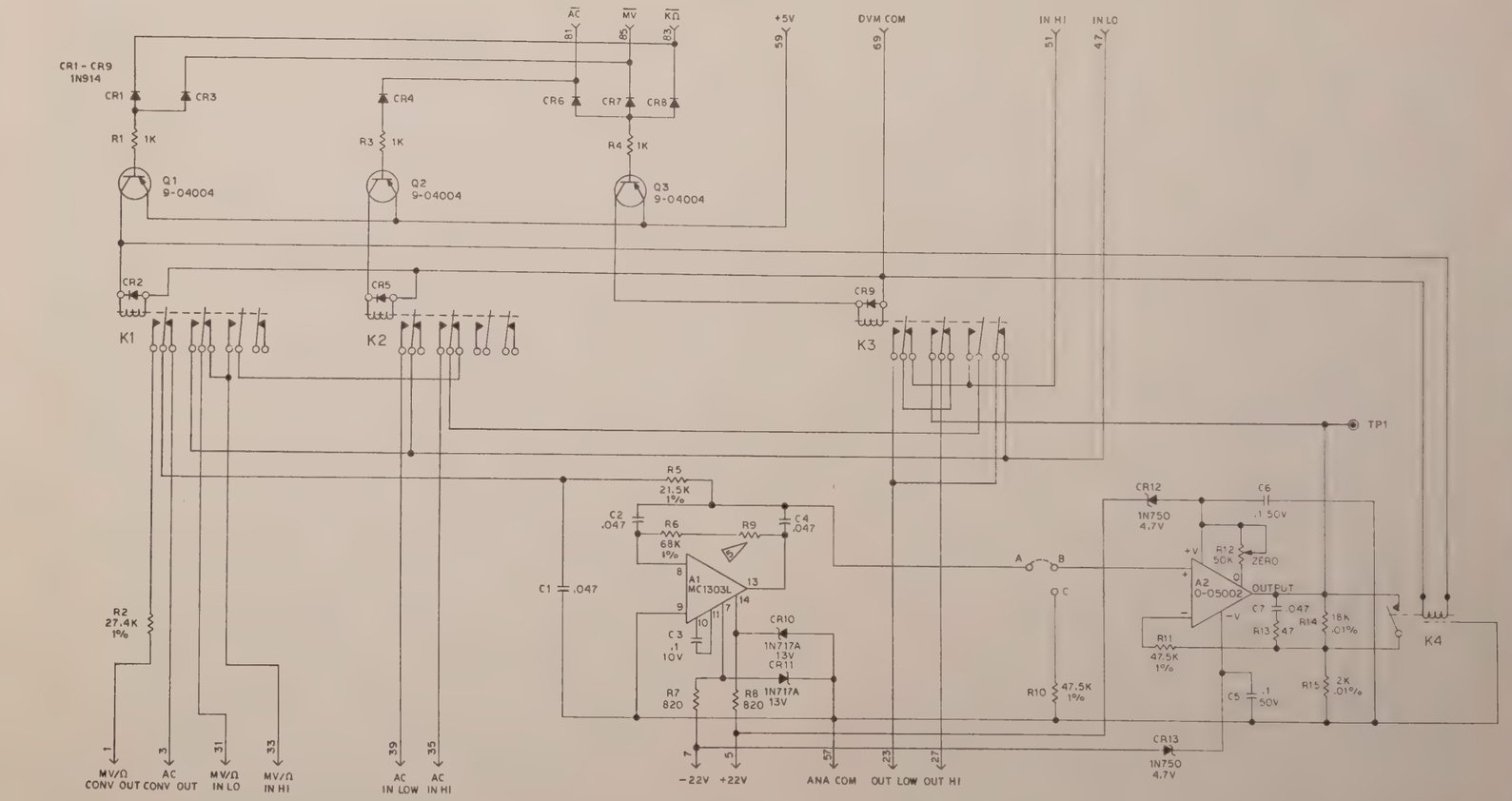
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A10)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7117-5		15318
2	18	CONTACT–ELECT		2-63904	5001-1923	91662
3	1	AMPLIFIER	A2	0-05002		15318
4	2	CAP MET PAP 0.1 10% 50V	C5,C6	1-57321	VX5A104K	12406
5	1	CAP MET PAP 0.047 10% 50V	C7	1-57327	VX5A473K	12406
6	3	CAP POLY 0.047 10% 100V	C1,C2,C4	1-57383	PD1A473K	12406
7	1	CAP CER DISC 0.1 10V	C3	1-57525	HY320	56289
8	1	TEST POINT JACK–BROWN	TP1	5-19004	TJ-51-4	82042
9	1	RELAY	K4	7-38228	R2191-1	15636
10	3	RELAY	K1-K3	7-38233	R10E730-1	24796
11	1	RES COMP 47	R13	7-41227	RC07GF470J	MIL-R-11
12	2	RES COMP 820	R7-R8	7-41242	RC07GF821J	MIL-R-11
13	3	RES COMP 1K	R1,R3,R4	7-41243	RC07GF102J	MIL-R-11
14	2	RES T.O. 47.5K 1%	R10,R11	7-46702	RN60D4752F	MIL-R-10509
15	1	RES T.O. 21.5K 1%	R5	7-46727	RN60D2152F	MIL-R-10509
16	1	RES T.O. 68K 1%	R6	7-46762	RN60D6802F	MIL-R-10509
17	1	RES T.O. 27.4K 1%	R2	7-46791	RN60D2742F	MIL-R-10509
18	1	RES WW 2K 0.01%	R15	7-47290	1368P	07088
19	1	RES 18K 0.01%	R14	7-47350	1368P	07088
20	1	RES VAR TRIM 50K	R12	7-54270	6010P-503	72314
21	2	SEMICOND ZENER	CR12, CR13	7-95608	1N750	JEDEC
22	2	SEMICOND ZENER	CR10,CR11	7-95635	1N717A	JEDEC
23	9	SEMICOND DIODE	CR1-CR9	7-95647	1N914	JEDEC
24	1	AMPLIFIER	A1	7-96045	MC1303L	15873
25	3	TRANSISTOR	Q1-Q3	9-04004	2N2907	JEDEC
26	1	RES–NOMINAL VALUE	R9			

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A10

Figure 6-3. Input Selector Assembly.



5 SELECTED VALUE
K4,TP1,Q3
4. R15,C7,CR13,A2 | NONE
LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A10
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
NOTES: UNLESS OTHERWISE SPECIFIED:

	K1	K2	K3	K4
DC	—	—	—	—
MV	X	—	X	X
KΩ	X	—	X	X
AC	—	X	X	—

Diagram 2. Input Selector Schematic.

MODEL 5676 AC CONVERTER

ASSEMBLY 57-6000

PARTS LIST

ASSEMBLY: AC Converter Model 5676			SCHEMATIC NO.: 57-0700		PART NO.: 57-6000
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A13)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD—ETCHED		57-7000-7		15318
2	12	CONTACT ELECT		2-63904	5001-1923	91662
3	1	RES KIT	R1,R4,R6,R8, R10,R12,R13	57-0500-1		15318
4	1	RES KIT	R15,R27,R28	57-0501-1		15318
5	1	CAP TANT 330 6V	C18	1-57101	SCM337HP-006D4	01295
6	1	CAP MET MY 0.5 1000V	C1	1-57357	ZD10A504K	12406
7	1	CAP MET MY 0.1 200V	C21	1-57370	ZA2C104K	27556
8	3	CAP SIL MICA 33 PF 500V	C19,C24,C25	1-57464	CM-15-E-330J	04062
9	2	CAP SIL MICA 50 PF 500V	C22,C23	1-57487	CM-15-E-500J	04062
10	2	CAP CER DISC 0.0047 1000V	C16,C17	1-57501	6P-247	90201
11	1	CAP CER DISC 0.0022 1000V	C20	1-57502	6P-222	90201
12	2	CAP GLASS 5100 PF 300V	C11,C12	1-57604	CYFM20C512J	07115
13	2	CAP GLASS 51 PF 500V	C2,C3	1-57613	CYFM10C510J	07115
14	1	CAP GLASS 91 PF 500V	C6	1-57619	CYFM10C910J	07115
15	1	CAP GLASS 1000 PF 300V	C8	1-57620	CYFM15C102J	07115
16	1	CAP GLASS 27 PF 500V	C4	1-57621	CYFM10C270J	07115
17	2	CAP VAR 0.8-30 PF 1000V	C9,C14	1-63000	VC43GW	73899
18	2	CAP VAR GLASS 0.8-18 PF 750V	C5,C7	1-63002	VC32GW	73899
19	2	RELAY REED	K2,K3	7-38228	R2191-1	15636
20	1	RELAY REED	K1	7-38231	R2204-1	24796
21	2	RES COMP 10	R23,R24	7-41219	RC07GF100J	MIL-R-11
22	3	RES COMP 82	R25,R29,R38	7-41230	RC07GF820J	MIL-R-11
23	2	RES COMP 390	R3,R14	7-41238	RC07GF391J	MIL-R-11
24	1	RES COMP 470	R32	7-41239	RC07GF471J	MIL-R-11
25	1	RES COMP 1.2K	R16	7-41244	RC07GF122J	MIL-R-11
26	1	RES COMP 2.2K	R39	7-41247	RC07GF222J	MIL-R-11
27	1	RES COMP 10K	R35	7-41255	RC07GF103J	MIL-R-11
28	1	RES COMP 15K	R34	7-41257	RC07GF153J	MIL-R-11
29	2	RES COMP 22K	R21,R22	7-41259	RC07GF223J	MIL-R-11
30	2	RES COMP 47K	R36,R37	7-41263	RC07GF473J	MIL-R-11
31	2	RES COMP 68K	R26,R30	7-41265	RC07GF683J	MIL-R-11

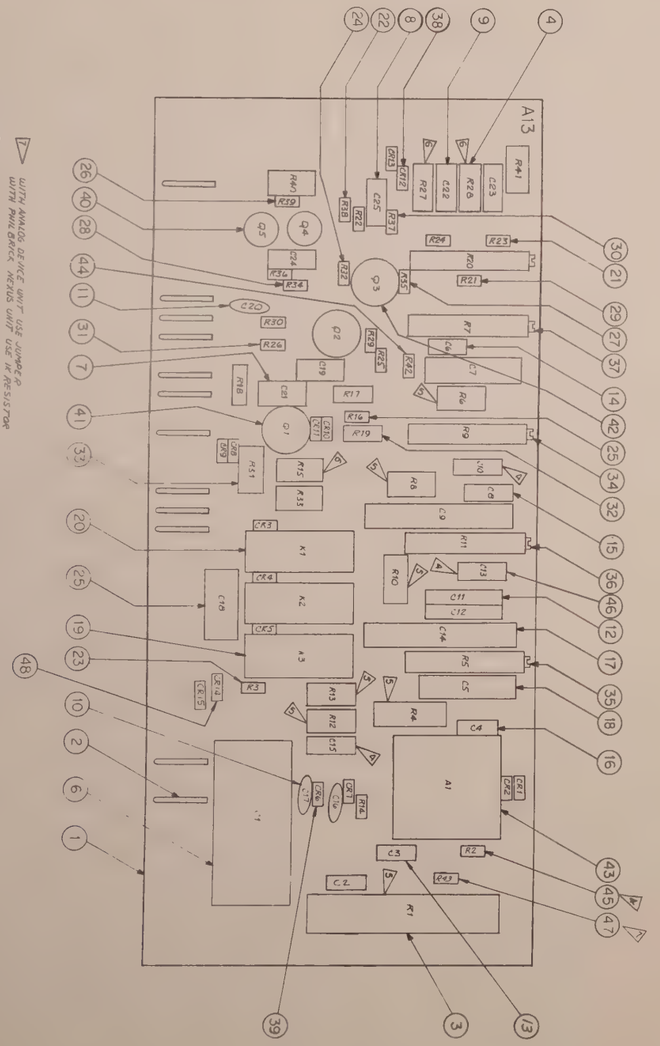
NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

ASSEMBLY: AC Converter Model 5676 SCHEMATIC NO.: 57-0700 PART NO.: 57-6000

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A13)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
32	3	RES T.O. 499K 1%	R17-R19	7-46772	RN60D4993J	MIL-R-10509
33	4	RES 55.4K 0.1%	R31,R33,R40,R41	7-47344	1846-PS	07088
34	1	RES 200	R9	7-54274	6023P-1-201	72314
35	1	RES 5K	R5	7-54276	6023P-1-502	72314
36	1	RES 20	R11	7-54278	6023P-1-200	72314
37	2	RES 2K	R7,R20	7-54279	6023P-1-202	72314
38	12	SEMICOND DIODE	CR1-CR5, CR8-CR13	7-95647	1N914	JEDEC
39	2	SEMICOND DIODE	CR6,CR7	7-95672	HY16B	71590
40	2	TRANSISTOR NPN	Q4,Q5	9-04001	2N930	JEDEC
41	2	TRANSISTOR DUAL NPN	Q1,Q2	9-04006		15318
42	1	TRANSISTOR DUAL PNP	Q3	9-04810	TP665	NONE
43	1	AMP	A1	67-0516-1		15318
44	1	RES COMP 68	R42	7-41229	RC07GF680J	MIL-R-11
45	1	RES COMP 3.3K (NOMINAL)	R2	7-41249		
46	3	CAP (SEL)	C10,C13,C15			
47	1	RES COMP 1K	R43	7-41243	RC07GF102J	MIL-R-11
48	1	DIODE ZENER	CR14	7-95631	1N708A	JEDEC

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A13

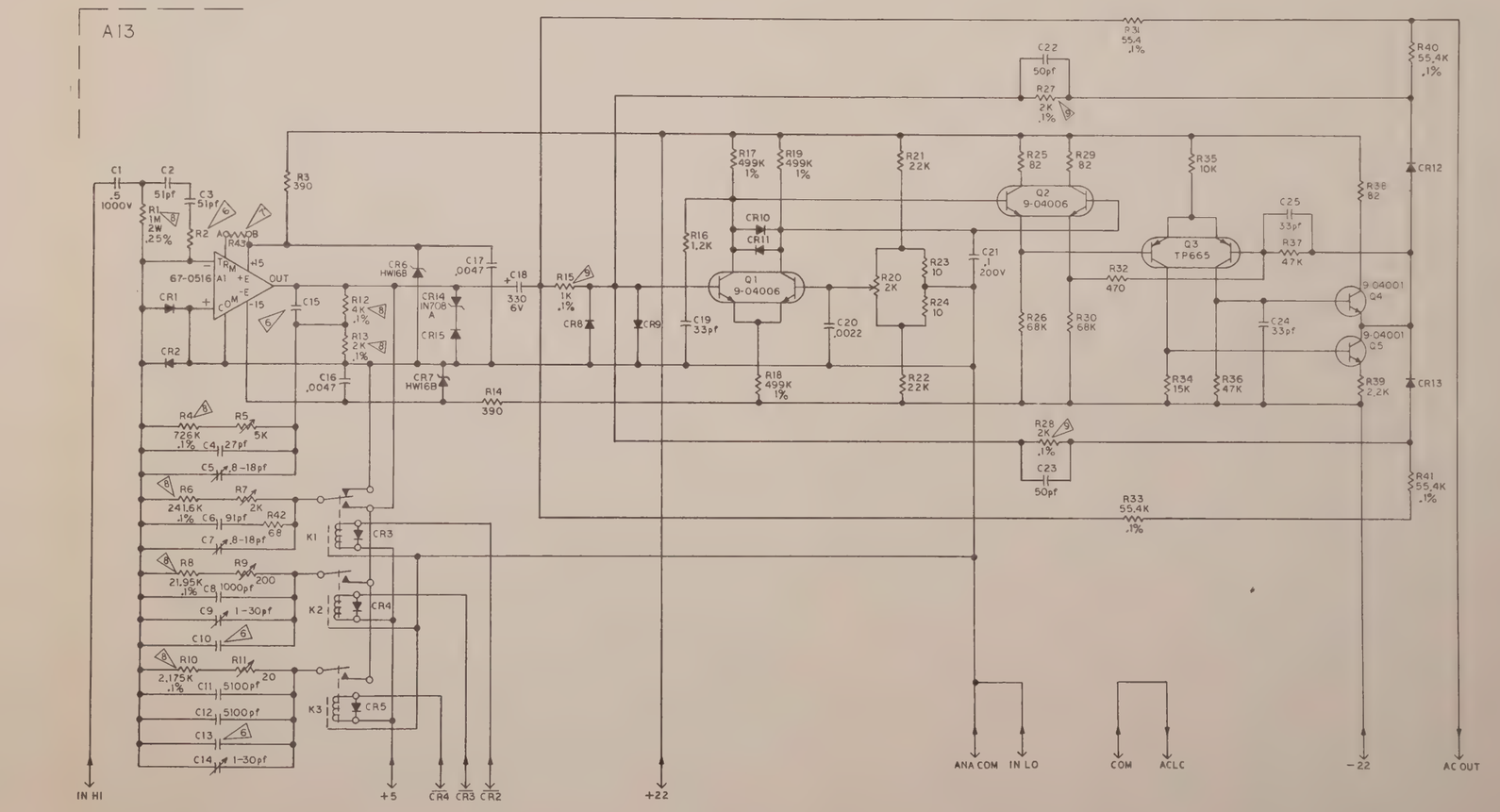
SELECTED VALUE

FURNISHED AS PART OF RES KIT 57-0501-1

FURNISHED AS PART OF RES KIT 57-0500-1

WITH ANALOG DEVICE UNIT USE JUMPER
WITH PHILBRICK NEXUS UNIT USE 1K RESISTOR

Figure 6-4. Model 5676 AC Converter Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A13
4. R43 — A1, C25, CR15, K3, Q5 — LAST NUMBER USED | NUMBER NOT USED
5. DIODES ARE IN914
6. FACTORY SELECTED VALUE

RESISTORS ARE PARTS OF RESISTOR KIT NO. 57-0501.

RESISTORS ARE PARTS OF RESISTOR KIT NO. 57-0500

WITH ANALOG DEVICE UNIT USE JUMPER
WITH PHILBRICK NEXUS UNIT USE 1K RESISTOR

Diagram 3. Model 5676 AC Converter Schematic.

MODEL 5689 MV/OHMS CONVERTER

ASSEMBLY 56-6014

PARTS LIST

ASSEMBLY: MV/Ohms Converter **SCHEMATIC NO.:** 56-0714 **PART NO.:** 56-6014

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A11)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD--ETCHED		56-7014A		15318
2	21	CONTACT ELEC		2-63904	5001-1923	91662
3	1	AMPLIFIER TP909	A1	66-0510		15318
4	1	TRANSFORMER	T1	68-0501		15318
5	7	COIL REED DRIVE	L1-L7	70-0511-1		15318
6	1	CAP MET PAP 1 50V 10%	C4	1-57317	VX5A105K	12406
7	2	CAP MET PAP 0.47 10% 50V	C6,C7	1-57318	VX5A474K	12406
8	3	CAP MET PAP 0.22 10% 50V	C2,C3,C5	1-57319	VX5A224K	12406
9	1	CAP POLY 1 10% 100V	C8	1-57361	PD1A105K	12406
10	1	CAP POLY 0.047 100V	C1	1-57383	PD1A473K	12406
11	1	CAP SIL MICA 180 PF 5% 500V	C9	1-57473	CM-15-E-181J	04062
12	1	CAP CER DISC 0.0047 10% 1KV	C10	1-57501	6P-247	90201
13	1	FUSE RESISTOR 100 1%	F1	4-09013		01686
14	1	FUSE RESISTOR 2K 5%	F2	4-09014		01686
15	7	RELAY REED	S1-S7	7-38216	MR-306-8	95348
16	1	RELAY 4P2T	K1	7-38223	R10-E419-1	24796
17	2	RES COMP 120	R72,R73	7-41232	RC07GF121J	MIL-R-11
18	2	RES COMP 330	R61,R62	7-41237	RC07GF331J	MIL-R-11
19	3	RES COMP 470	R71,R74,R80	7-41239	RC07GF471J	MIL-R-11
20	3	RES COMP 680	R33,R34,R76	7-41241	RC07GF681J	MIL-R-11
21	2	RES COMP 1K	R57,R58	7-41243	RC07GF102J	MIL-R-11
22	1	RES COMP 1.5K	R75	7-41245	RC07GF152J	MIL-R-11
23	9	RES COMP 4.7K	R1-R9	7-41251	RC07GF472J	MIL-R-11
24	2	RES COMP 10K	R68,R69	7-41255	RC07GF103J	MIL-R-11
25	4	RES COMP 15K	R39, R41, R56, R79	7-41257	RC07GF153J	MIL-R-11
26	1	RES COMP 22K	R77	7-41259	RC07GF223J	MIL-R-11
27	6	RES COMP 33K	R47,R49,R51, R52,R54,R55	7-41261	RC07GF333J	MIL-R-11
28	3	RES COMP 47K	R48,R50,R53	7-41263	RC07GF473J	MIL-R-11
29	2	RES COMP 100K	R59,R60	7-41267	RC07GF104J	MIL-R-11
30	1	RES COMP 1M	R29	7-41279	RC07GF105J	MIL-R-11

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

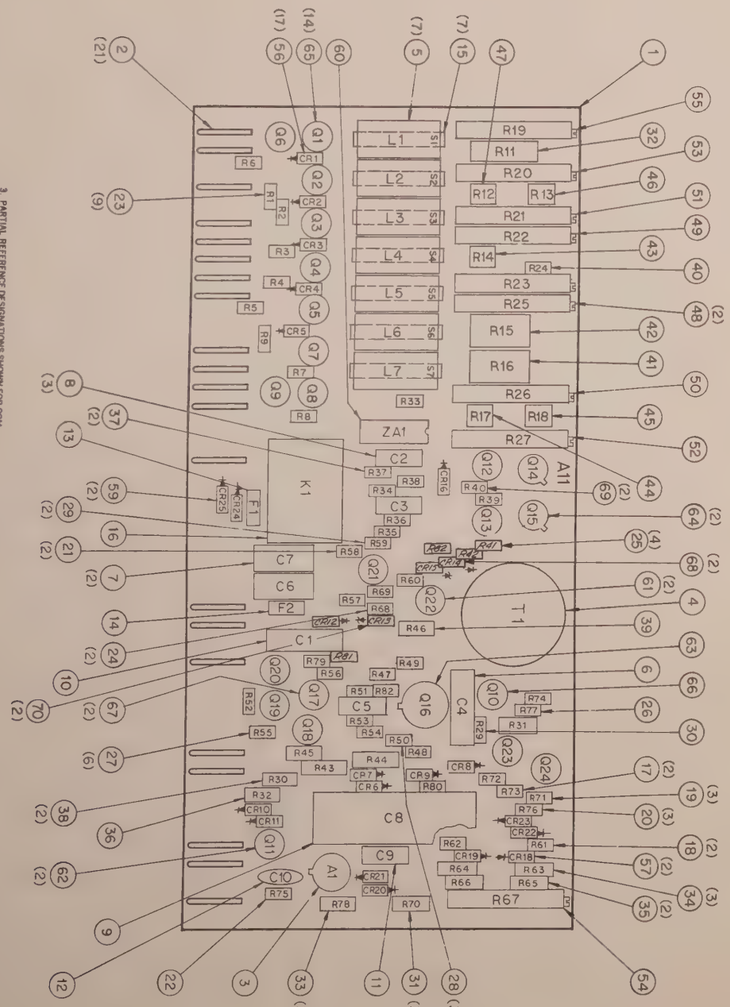
ASSEMBLY: MV/Ohms Converter			SCHEMATIC NO.: 56-0714		PART NO.: 56-6014	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A11)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
31	3	RES MET FILM 1% 1M	R43,R44,R70	7-46220	RN65C	07716
32	1	RES MET FILM 10.750M 1/2W	R11	7-46224	PME 70T9	03888
33	3	RES TIN OXIDE 4.75K 1%	R36,R38,R78	7-46700	RN60D4751F	MIL-R-10509
34	3	RES TIN OXIDE 10K 1%	R45,R63,R64	7-46701	RN60D1002F	MIL-R-10509
35	2	RES TIN OXIDE 2.74K 1%	R65,R66	7-46703	RN60D2741F	MIL-R-10509
36	1	RES TIN OXIDE 100K 1%	R32	7-46716	RN60D1003F	MIL-R-10509
37	2	RES TIN OXIDE 15K 1%	R35,R37	7-46717	RN60D1502F	MIL-R-10509
38	2	RES TIN OXIDE 21.5K 1%	R30,R31	7-46727	RN60D2152F	MIL-R-10509
39	1	RES WW 100 0.1%	R46	7-47111	TYPE OD	07088
40	1	RES COMP 10	R24	7-41219	RC07GF100J	MIL-R-11
41	1	RES WW 905.5 0.1% 1/2W	R16	7-47330	815P	07088
42	1	RES WW 995 0.1% 1/2W	R15	7-47331	815P	07088
43	1	RES WW 10.875K 0.1%	R14	7-47332	1368P	07088
44	1	RES WW 10.94K 0.1%	R17	7-47333	1368P	07088
45	1	RES WW 99.4K 0.1%	R18	7-47334	1368P	07088
46	1	RES WW 109.8K 0.1%	R13	7-47335	1368P	07088
47	1	RES WW 1.0974M 0.1%	R12	7-47336	1368P	07088
48	2	RES VAR 10	R23,R25	7-54252	8PC	Not Known
49	1	RES VAR 50	R22	7-54253	8PC	Not Known
50	1	RES VAR 100	R26	7-54254	8PC	Not Known
51	1	RES VAR 200	R21	7-54255	8PC	Not Known
52	1	RES VAR 1K	R27	7-54256	8PC	Not Known
53	1	RES VAR 5K	R20	7-54257	8PC	Not Known
54	1	RES VAR 10K	R67	7-54258	8PC	Not Known
55	1	RES VAR 500K	R19	7-54266	8PC	Not Known
56	17	SEMICOND DIODE	CR1-CR11,CR16-CR17,CR20-CR23	7-95647	1N914	JEDEC
57	2	DIODE ZENER	CR18,CR19	7-95672	HW-16B	71590
58						
59	2	DIODE ZENER	CR24,CR25	7-95676	HW-18A	71590
60	1	DUAL BUFFER–4 INPUT	ZA1	7-96004	MC832P	15873
61	2	TRANSISTOR FET	Q21,Q22	9-04733	2N4302	JEDEC

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

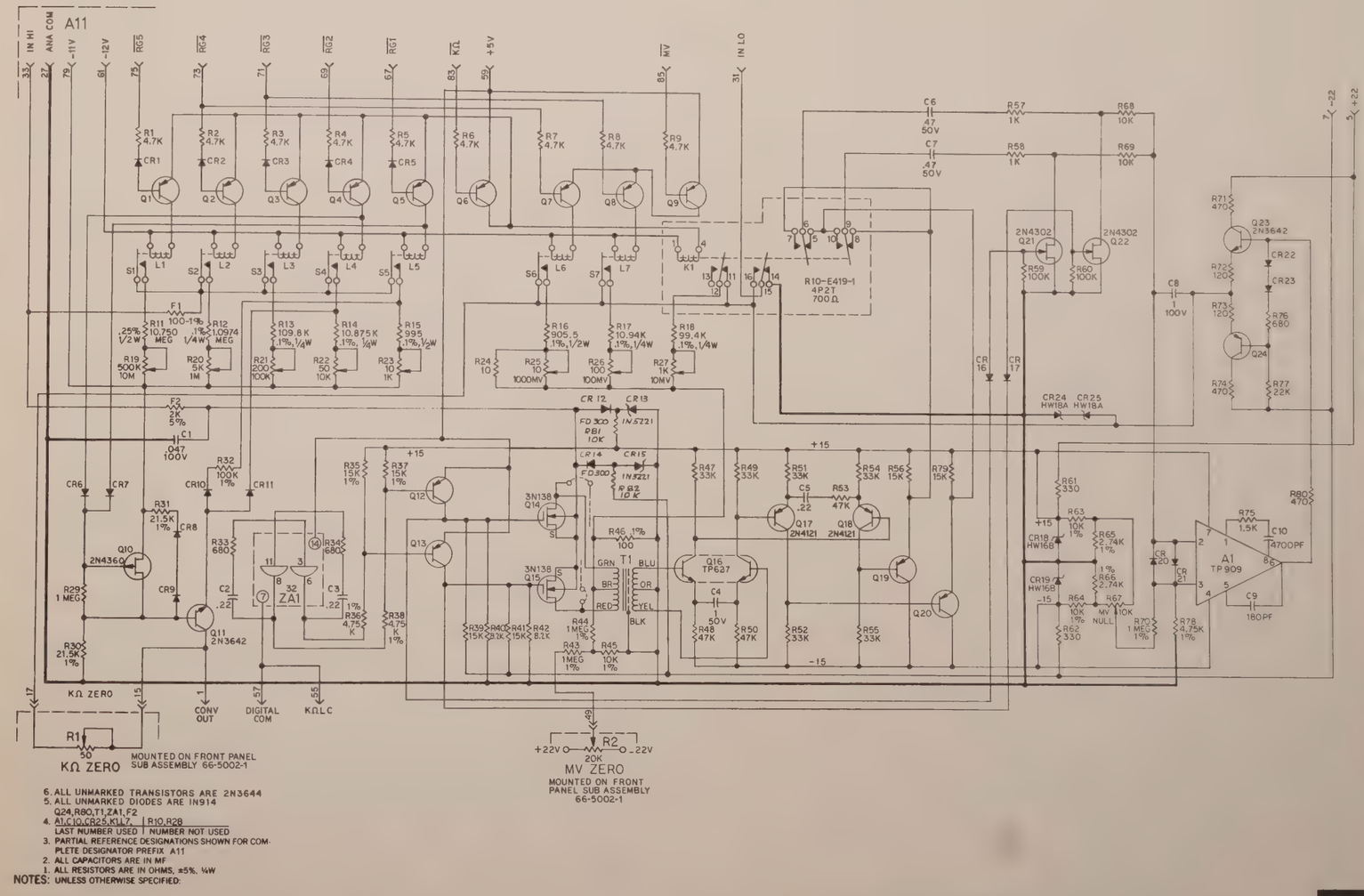
ASSEMBLY: MV/Ohms Converter			SCHEMATIC NO.: 56-0714		PART NO.: 56-6014	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A11)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
62	2	TRANSISTOR	Q11,Q23	9-04737	2N3642	JEDEC
63	1	TRANSISTOR	Q16	9-04749	TP627	Not Known
64	2	TRANSISTOR (MOS FET)	Q14,Q15	9-04757	3N138	JEDEC
65	14	TRANSISTOR	Q1-Q9,Q12,Q13, Q19,Q20,Q24	9-04808	2N3644	JEDEC
66	1	TRANSISTOR (FET)	Q10	9-04815	2N4360	JEDEC
67	2	TRANSISTOR	Q17,Q18	9-04806	2N4121	JEDEC
68	2	SEMICOND DIODE	CR12, CR14	7-95505	FD300	72314
69	2	RES COMP 8.2K	R40, R42	7-41254	RC07GF820J	MIL-R-11
70	2	SEMICOND DIODE	CR13, CR15	7-95706	IN5221	15873

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A11

Figure 6-5. Model 5689 MV/Ohms Converter Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A11
4. A1,C10,CR25,K1L7, | R10,R28 — LAST NUMBER USED | NUMBER NOT USED
5. ALL UNMARKED DIODES ARE IN914
6. ALL UNMARKED TRANSISTORS ARE 2N3644

Diagram 4. Model 5689 MV/Ohms Converter Schematic.

DECODER AND INPUT AMPLIFIER

ASSEMBLY 66-5036

AND

INPUT AMPLIFIER

SUBASSEMBLY 66-6116

PARTS LIST

ASSEMBLY:	Input Amplifier & Decoder			PART NO.:	66-5036
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	DECODER ASSEMBLY		66-6073-3		15318
2	1	INPUT AMPLIFIER		66-6116-1		15318
3	1	RESISTOR–RATIOED SET	R1-R22	66-0511-1		15318

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

SUBASSEMBLY: Input Amplifier SCHEMATIC NO.: 66-0816 PART NO.: 66-6116

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A8)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7116-5		15318
2	21	CONTACT–ELECT		2-63904	5001-1923	91662
3	1	AMPLIFIER	A2	66-0510-1	TP909	15318
4	3	TRANSISTOR	Q7,Q8,Q11	66-0517-1		15318
5	5	CAP MET PAP 0.1 50V 10%	C12,C15,C16, C18-C20	1-57321	VX5A104K	12406
6	1	CAP MET PAP 0.022 50V 10%	C9	1-57326	VX5A223K	12406
7	1	CAP MET PAP 0.047 50V 10%	C10	1-57327	VX5A473K	12406
8	4	CAP POLY 0.015 100V 5%	C1,C4,C5,C8	1-57395	PA2B153J	27556
9	2	CAP POLY 0.01 100V 5%	C2,C6	1-57396	PA2B103J	27556
10	1	CAP SIL MICA 33 PF 500V 5%	C17	1-57464	CM-15-E-330J	04062
11	1	CAP SIL MICA 430 PF 300V 5%	C13	1-57481	CM-15-E-431J	04062
12	1	CAP SIL MICA 360 PF 500V 5%	C14	1-57488	CM-15-E-361J	04062
13	2	CAP CER DISC 0.1 10V	C3,C7	1-57525	HY320	56289
14	1	TEST POINT JACK–BLUE	TP6	5-19007	TJ-51-7	82042
15	1	TEST POINT JACK–YELLOW	TP4	5-19008	TJ-51-8	82042
16	1	TEST POINT JACK–PURPLE	TP7	5-19010	TJ-51-10	82042
17	1	KIT–RESISTOR	R1A,R1B,R1C	5-40021	M-117,102,101	07088
18	1	LAMP–GLOW NEON	DS1	5-46501	NE-2P	08806
19	2	RELAY REED	S2,S3	7-38208	DRG-1	12617
20	1	RELAY REED	S1	7-38211	DRR-5	12617
21	4	RELAY REED	S4-S7	7-38216	MR-306-8	95348
22	1	RES COMP 100	R30	7-41231	RC07GF101J	MIL-R-11
23	2	RES COMP 470	R46,R48	7-41239	RC07GF471J	MIL-R-11
24	3	RES COMP 1K	R37,R39,R60	7-41243	RC07GF102J	MIL-R-11
25	1	RES COMP 1.2K	R45	7-41244	RC07GF122J	MIL-R-11
26	1	RES COMP 1.5K	R43	7-41245	RC07GF152J	MIL-R-11
27	2	RES COMP 2.2K	R61-R62	7-41247	RC07GF222J	MIL-R-11
28	1	RES COMP 3.3K	R47	7-41249	RC07GF332J	MIL-R-11
29	1	RES COMP 4.7K	R18	7-41251	RC07GF472J	MIL-R-11
30	2	RES COMP 10K	R32,R34	7-41255	RC07GF103J	MIL-R-11
31	2	RES COMP 27K	R7,R12	7-41260	RC07GF273J	MIL-R-11

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

SUBASSEMBLY: Input Amplifier SCHEMATIC NO.: 66-0816 PART NO.: 66-6116

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A8)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
32	1	RES COMP 100K	R42	7-41267	RC07GF104J	MIL-R-11
33	1	RES COMP 120K	R59	7-41268	RC07GF124J	MIL-R-11
34	1	RES COMP 330K	R38	7-41273	RC07GF334J	MIL-R-11
35	1	RES COMP 680K	R35	7-41277	RC07GF684J	MIL-R-11
36	1	RES COMP 910	R44	7-41303	RC07GF911J	MIL-R-11
37	1	RES COMP 560K 2W	R2	7-45076	RC42GF564J	MIL-R-11
38	1	RES MET FILM 7.68M 1%	R11	7-46230	PME65	03888
39	2	RES TIN OXIDE 10K 1%	R49,R52	7-46701	RN60D1002F	MIL-R-10509
40	2	RES TIN OXIDE 100 1%	R50,R51	7-46707	RN60D1000F	MIL-R-10509
41	1	RES TIN OXIDE 392 1%	R55	7-46712	RN60D3920F	MIL-R-10509
42	2	RES TIN OXIDE 12.1K 1%	R14,R28	7-46736	RN60D1212F	MIL-R-10509
43	2	RES TIN OXIDE 2K 1%	R56,R58	7-46747	RN60D2000F	MIL-R-10509
44	1	RES TIN OXIDE 301K 1%	R19	7-46749	RN60D3014F	MIL-R-10509
45	2	RES TIN OXIDE 18.2K 1%	R33,R57	7-46750	RN60D1822F	MIL-R-10509
46	1	RES TIN OXIDE 107K 1%	R31	7-46751	RN60D1073F	MIL-R-10509
47	1	RES TIN OXIDE 178 1%	R53	7-46752	RN60D1780F	MIL-R-10509
48	2	RES TIN OXIDE 432K 1%	R17,R27	7-46760	RN60D4323F	MIL-R-10509
49	1	RES TIN OXIDE 499K 1%	R25	7-46772	RN60D4993F	MIL-R-10509
50	1	RES TIN OXIDE 2.32K 1%	R26	7-46810	RN60D2321F	MIL-R-10509
51	1	RES TIN OXIDE 562K 1%	R5	7-46845	RN60D5623F	MIL-R-10509
52	2	RES TIN OXIDE 280K 1%	R9,R10	7-46846	RN60D2803F	MIL-R-10509
53	1	RES TIN OXIDE 1.69M 1%	R6	7-46847	RN65D1691F	MIL-R-10509
54	2	RES WW 5K 1%	R23,R29	7-47190	TYPE OB	07088
55	1	RES WW 400K 1%	R41	7-47303	1368P	07088
56	1	RES WW 2.315K 0.1%	R36	7-47329	1368P	07088
57	1	RES VAR TRIM WW 10K	R3	7-54103	275-1-103	80294
58	1	RES VAR TRIM WW 500	R4	7-54206	275-1-501	80294
59	1	RES VAR TRIM WW 5K	R24	7-54207	275-1-502	80294
60	2	RES VAR TRIM WW 1K	R20,R54	7-54211	275-1-102	80294
61	1	RES MET FILM 50K	R40	7-54292	78PR50K	73138
62	1	SEMICOND ZENER	CR14	7-95630	1N714A	JEDEC
63	16	SEMICOND DIODE	CR1-CR9,CR12, CR13,CR15,CR16 CR24,CR25	7-95647	1N914	JEDEC

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

SUBASSEMBLY: Input Amplifier SCHEMATIC NO.: 66-0816 PART NO.: 66-6116

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A8)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
64	1	SEMICOND ZENER	CR22	7-95653	1N961B	JEDEC
65	2	SEMICOND ZENER	CR10,CR11	7-95654	1N751	JEDEC
66	2	SEMICOND ZENER	CR19,CR20	7-95655	1N755	JEDEC
67	1	SEMICOND ZENER	CR21	7-95657	1N966B	JEDEC
68	2	SEMICOND ZENER	CR17,CR18	7-95665	1N823	JEDEC
69	1	AMPL–μA710C	A3	7-96013	U5B771039X	72314
70	1	AMPL DUAL STEREO	A1	7-96045	MC1303L	15873
71	4	TURRET TERMINAL	TP1-TP3,TP5	8-91110	35-3	05704
72	1	TRANSISTOR	Q6	9-04001	2N930	JEDEC
73	2	TRANSISTOR	Q13,Q14	9-04002	2N2192	JEDEC
74	2	TRANSISTOR	Q9,Q10	9-04003	2N2222	JEDEC
75	1	TRANSISTOR	Q5	9-04007	2N2920	JEDEC
76	1	TRANSISTOR	Q4	9-04008		15318
77	2	TRANSISTOR	Q1,Q2	9-04733	2N4302	JEDEC
78	1	TRANSISTOR	Q12	9-04811	TP139	Not Known
79	2	COIL REED DRIVE	L2,L3	70-0501-1		15318
80	2	COIL DUAL	L4,L5	80-0501-1		15318
81	1	COIL REED DRIVE	L1	80-0508-1		15318
82	1	CAP (SELECTED)	C11			
83	4	RES (SELECTED)	R8,R13,R15,R16			
84	2	CAP CER DISC 560 PF	C21,C22	1-57500	DD-561	71590
85	1	RES COMP 330 5% 1/2W	R63	7-41037	RC20GF331J	MIL-R-11
86	1	SEMICOND ZENER	CR23	7-95680	1N759A	JEDEC
87	1	SEMICOND DIODE	CR27	7-95505	FD300	72314

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

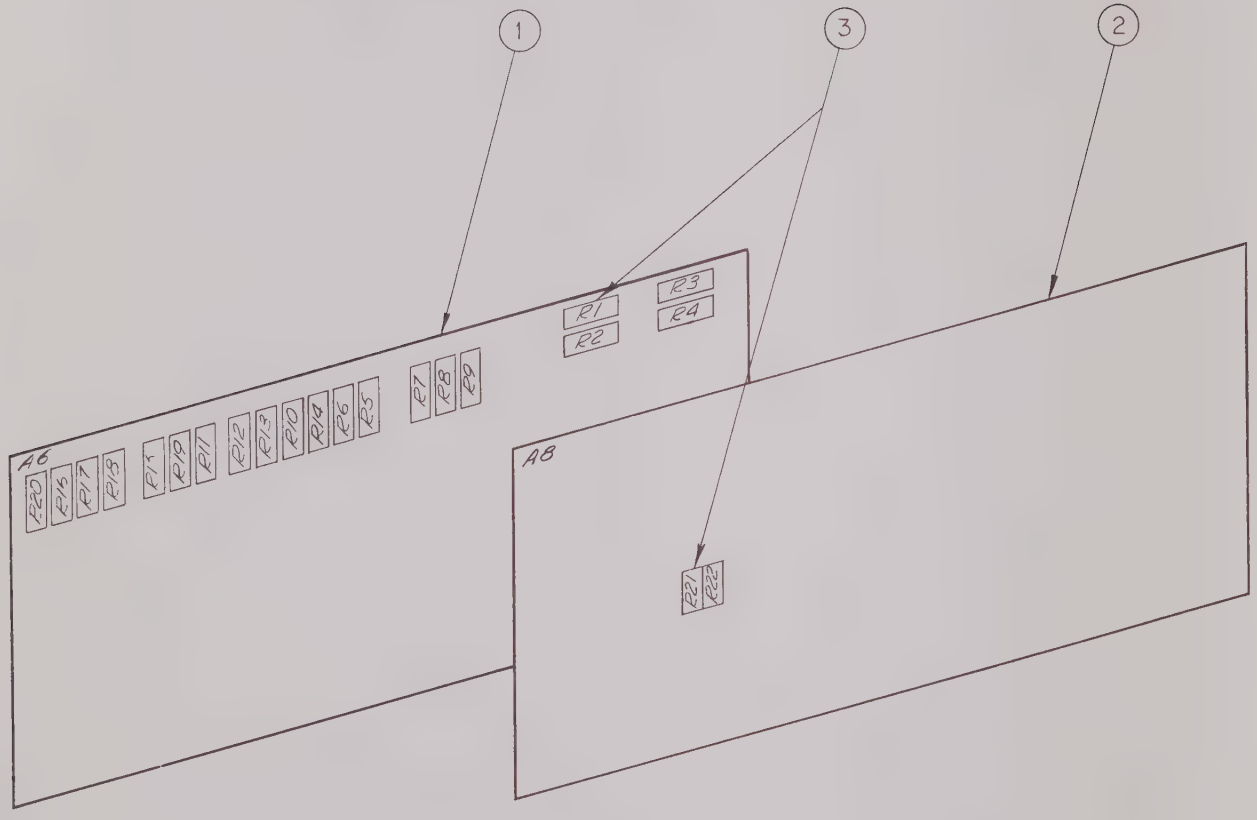


Figure 6-6. Decoder/Input Amplifier Assembly.

NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A8
▽ FURNISHED AS MATCHED SET 66-0511-1

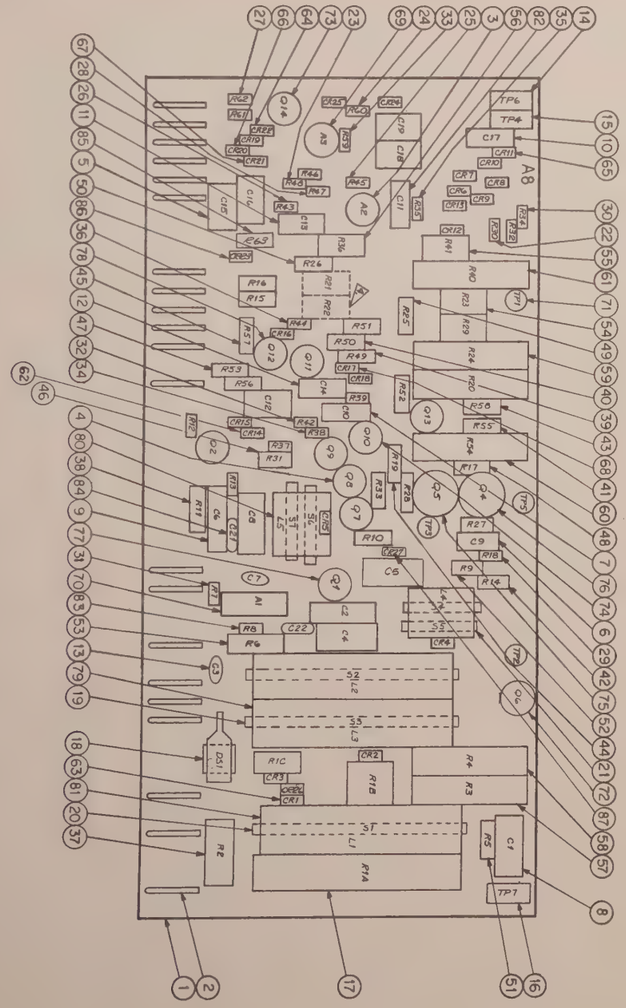
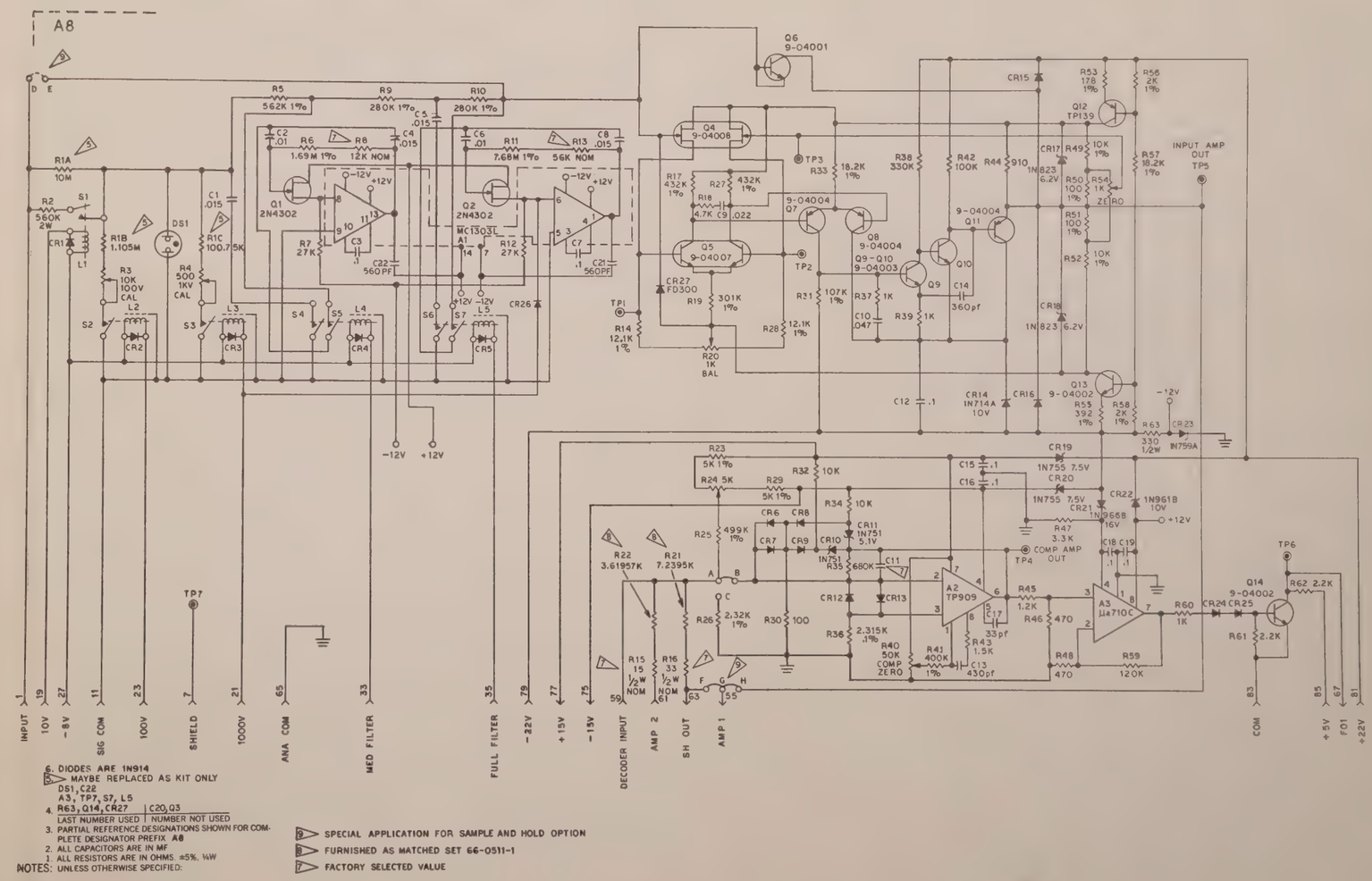


Figure 6-7. Input Amplifier Subassembly.



6. DIODES ARE 1N914
▽ MAYBE REPLACED AS KIT ONLY
DS1, C22
A3, TP7, S7, L5
4. R63, Q14, CR27 | C20, Q3
LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A8
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
NOTES: UNLESS OTHERWISE SPECIFIED:

▽ SPECIAL APPLICATION FOR SAMPLE AND HOLD OPTION
▽ FURNISHED AS MATCHED SET 66-0511-1
▽ FACTORY SELECTED VALUE

Diagram 5. Input Amplifier Schematic

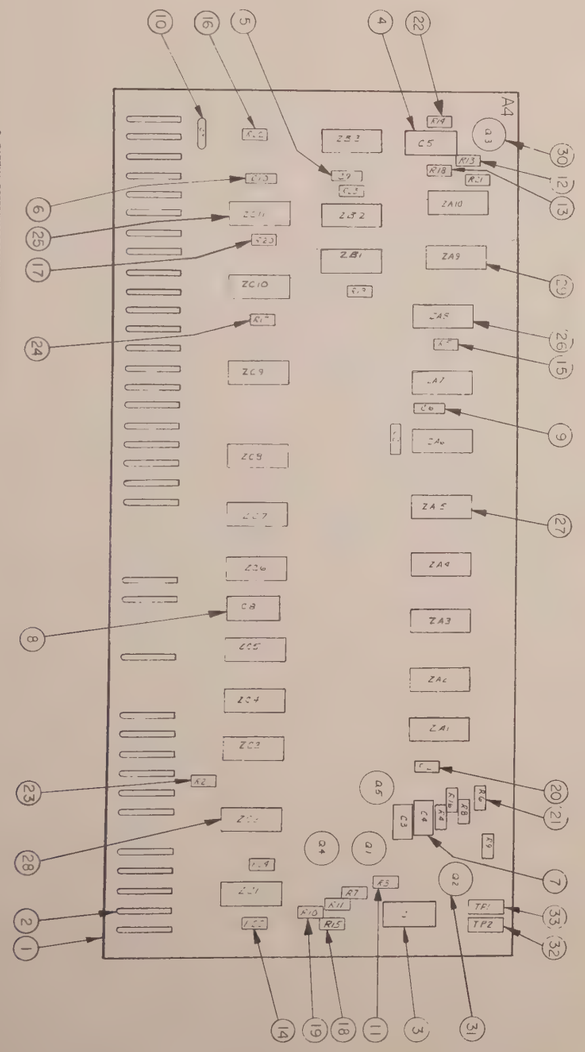
PROGRAM CONTROL

ASSEMBLY 66-6136

PARTS LIST

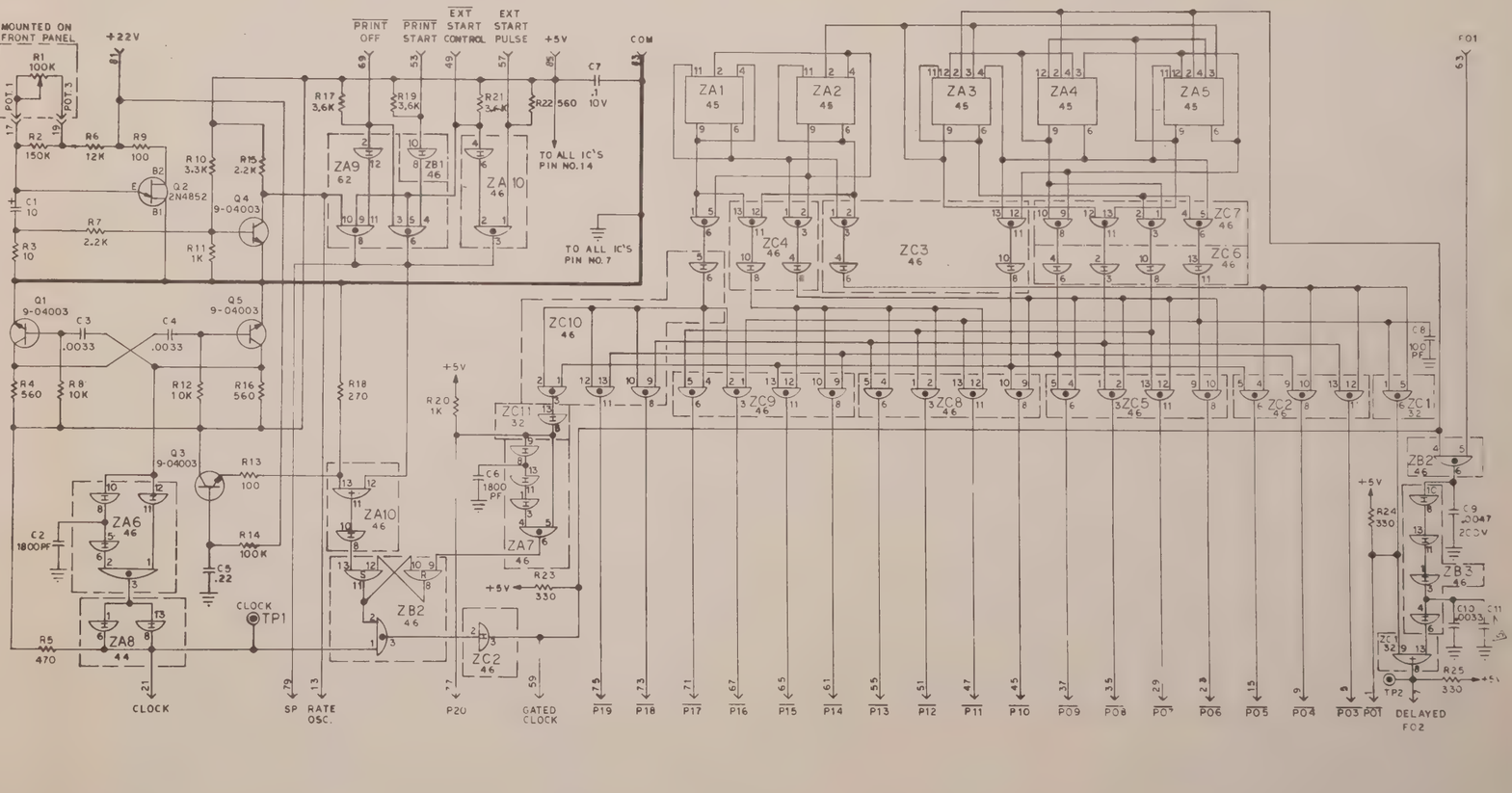
ASSEMBLY: Program Control			SCHEMATIC NO.: 66-0836		PART NO.: 66-6136	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A4)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7136-1		15318
2	35	CONTACT–ELECT		2-63904	5001-1923	91662
3	1	CAP TANT 10 10% 20V	C1	1-57112	150D106X9020-B2	56289
4	1	CAP MET PAP 0.22 10% 50V	C5	1-57319	VX5A224K	12406
5	1	CAP MET MYLAR 0.0047 200V	C9	1-57365	ZD2R472K	12406
6	1	CAP MOLDED MYLAR 0.0033 200V	C10	1-57368	4M332K	96733
7	2	CAP MET MYLAR 0.0033 200V	C3,C4	1-57373	ZA2C332K	27556
8	1	CAP SIL MICA 100 PF	C8	1-57469	CM15E101J	04062
9	2	CAP MET MYLAR 0.0018 200V	C2,C6	1-57521	CK06CW182K	
10	1	CAP CER DISC 0.1 10V	C7	1-57525	HY320	56289
11	1	RES COMP 10	R3	7-41219	RC07GF100J	MIL-R-11
12	2	RES COMP 100	R9,R13	7-41231	RC07GF101J	MIL-R-11
13	1	RES COMP 270	R18	7-41236	RC07GF271J	MIL-R-11
14	3	RES COMP 330	R23-R25	7-41237	RC07GF331J	MIL-R-11
15	1	RES COMP 470	R5	7-41239	RC07GF471J	MIL-R-11
16	3	RES COMP 560	R4,R16,R22	7-41240	RC07GF561J	MIL-R-11
17	2	RES COMP 1K	R11,R20	7-41243	RC07GF102J	MIL-R-11
18	2	RES COMP 2.2K	R7,R15	7-41247	RC07GF222J	MIL-R-11
19	1	RES COMP 3.3K	R10	7-41249	RC07GF332J	MIL-R-11
20	2	RES COMP 10K	R8,R12	7-41255	RC07GF103J	MIL-R-11
21	1	RES COMP 12K	R6	7-41256	RC07GF123J	MIL-R-11
22	1	RES COMP 100K	R14	7-41267	RC07GF104J	MIL-R-11
23	1	RES COMP 150K	R2	7-41269	RC07GF154J	MIL-R-11
24	3	RES COMP 3.6K	R17,R19,R21	7-41300	RC07GF362J	MIL-R-11
25	2	IC DUAL BUFFER	ZC1,ZC11	7-96004	MC832P	15873
26	1	IC DUAL PWR GATE	ZA8	7-96006	MC844P	15873
27	5	IC CLOCKED FLIP/FLOP	ZA1-ZA5	7-96007	MC845P	15873
28	15	IC QUAD 2 INPUT GATE	ZA6,ZA7,ZA10, ZB1-ZB3, ZC2-ZC10	7-96008	MC846P	15873
29	1	IC TRIPLE 3 INPUT GATE	ZA9	7-96010	MC862P	15873
30	4	TRANSISTOR	Q1,Q3-Q5	9-04003	2N2222	JEDEC
31	1	TRANSISTOR UNIJUNCTION	Q2	9-04402	2N4852	JEDEC
32	1	TEST POINT–RED	TP2	5-19002	TJ512	82042
33	1	TEST POINT–BROWN	TP1	5-19004	TJ514	82042

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A4

Figure 6-8. Program Control Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A4
4. C11, Q5, R25, TP2 | NONE
LAST NUMBER USED | NUMBER NOT USED
5. FACTORY SELECTED VALUE. ZA10, ZB3, ZC11.

Diagram 6. Program Control Schematic.

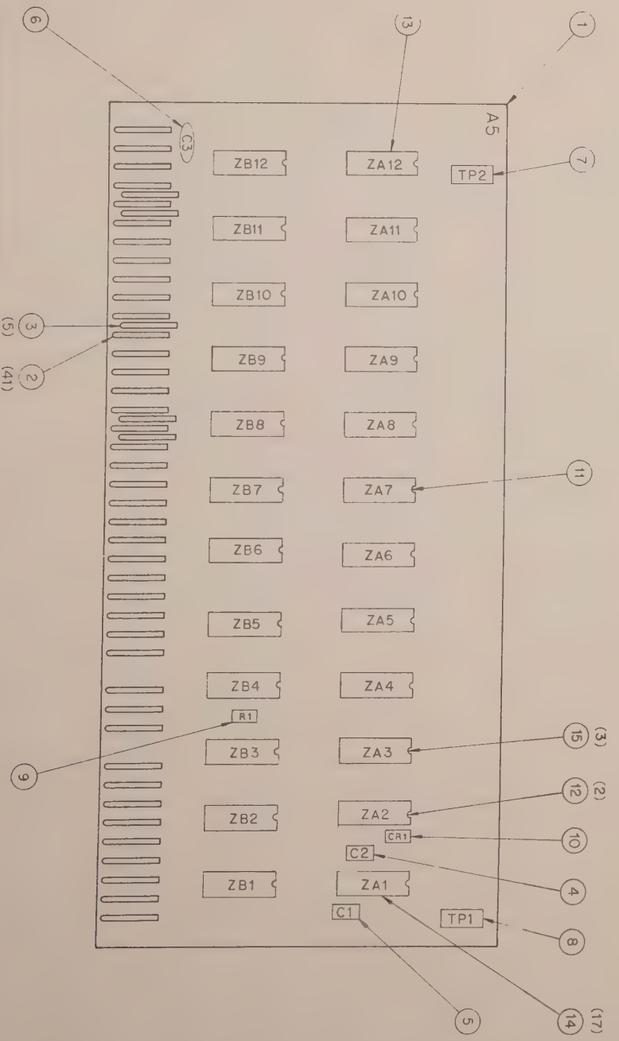
DECADE

ASSEMBLY 66-6074

PARTS LIST

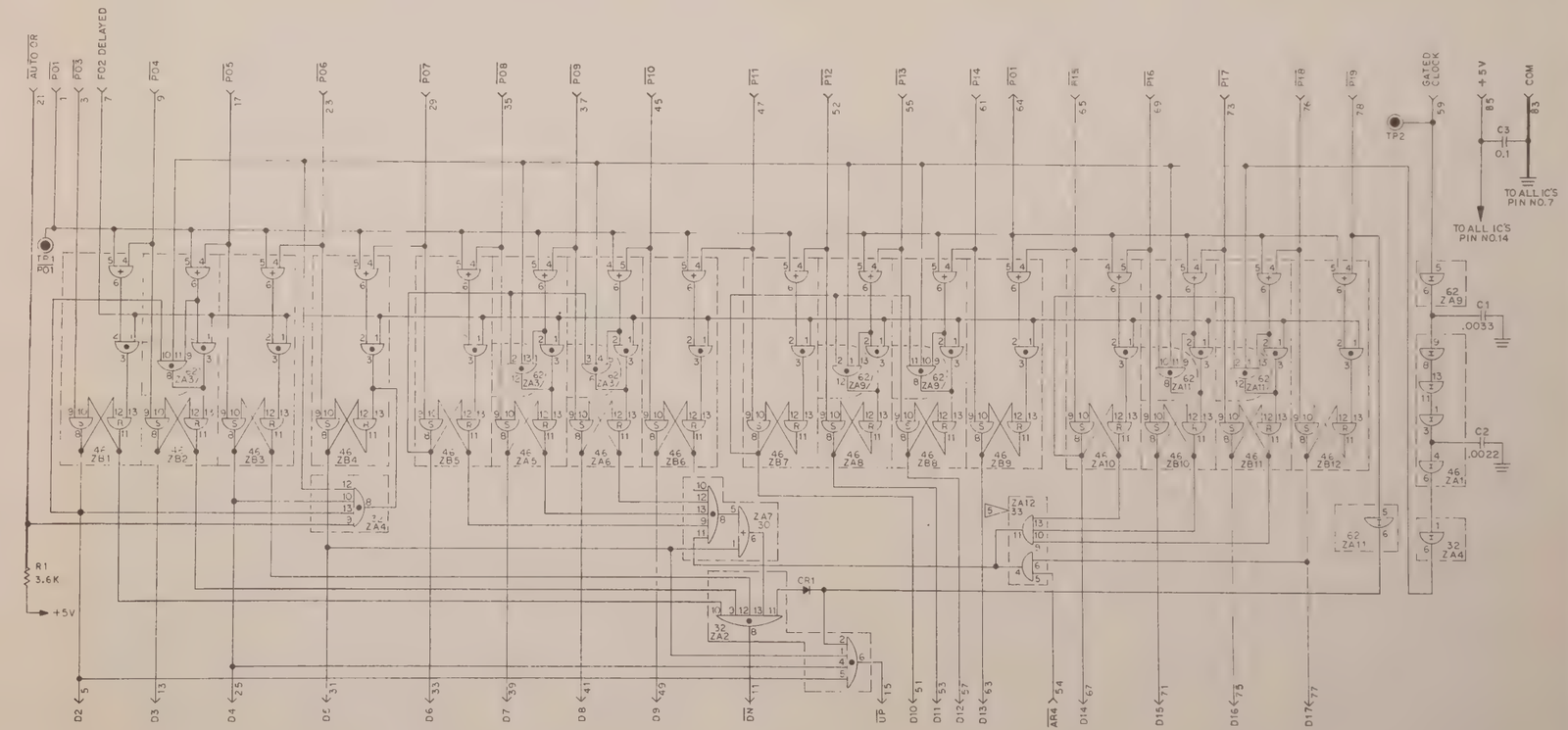
ASSEMBLY: Decade			SCHEMATIC NO.: 66-0774		PART NO.: 66-6074	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A5)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7074-1		15318
2	41	CONTACT–ELEC		2-63904	5001-1923	91662
3	5	CONTACT–ELEC		2-63907	7001-0523	91662
4	1	CAP MET MY 0.0022 10% 200V	C2	1-57351	215BIC222K2	14752
5	1	CAP MET MY 0.0033 10%	C1	1-57368	4M332K	96733
6	1	CAP CER DISC 0.1 10V	C3	1-57525	HY320	56289
7	1	TEST POINT JACK–RED	TP2	5-19002	TJ-51-2	82042
8	1	TEST POINT JACK–BROWN	TP1	5-19004	TJ-51-4	82042
9	1	RES COMP 3.6K	R1	7-41300	RC07GF362J	MIL-R-11
10	1	SEMICOND DIODE	CR1	7-95647	1N914	JEDEC
11	1	DUAL–4 INPUT GATE	ZA7	7-96002	MC830P	15873
12	2	DUAL BUFFER–4 INPUT	ZA2,ZA4	7-96004	MC832P	15873
13	1	GATE EXPANDER	ZA12	7-96005	MC833P	15873
14	17	QUAD–2 INPUT GATE	ZA1,ZA5,ZA6, ZA8,ZA10,ZB1 THRU ZB12	7-96008	MC846P	15873
15	3	TRIPLE–3 INPUT GATE	ZA3,ZA9,ZA11	7-96010	MC862P	15873

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A5

Figure 6-9. Decade Assembly.



5 > ZA12 IS A NON-INVERTING DIODE EXPANDER

R1

4. C3,CR1,ZA12,ZB12,TP2 NONE
   LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A5
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

NOTES: UNLESS OTHERWISE SPECIFIED

Diagram 7. Decade Schematic.

DECODER

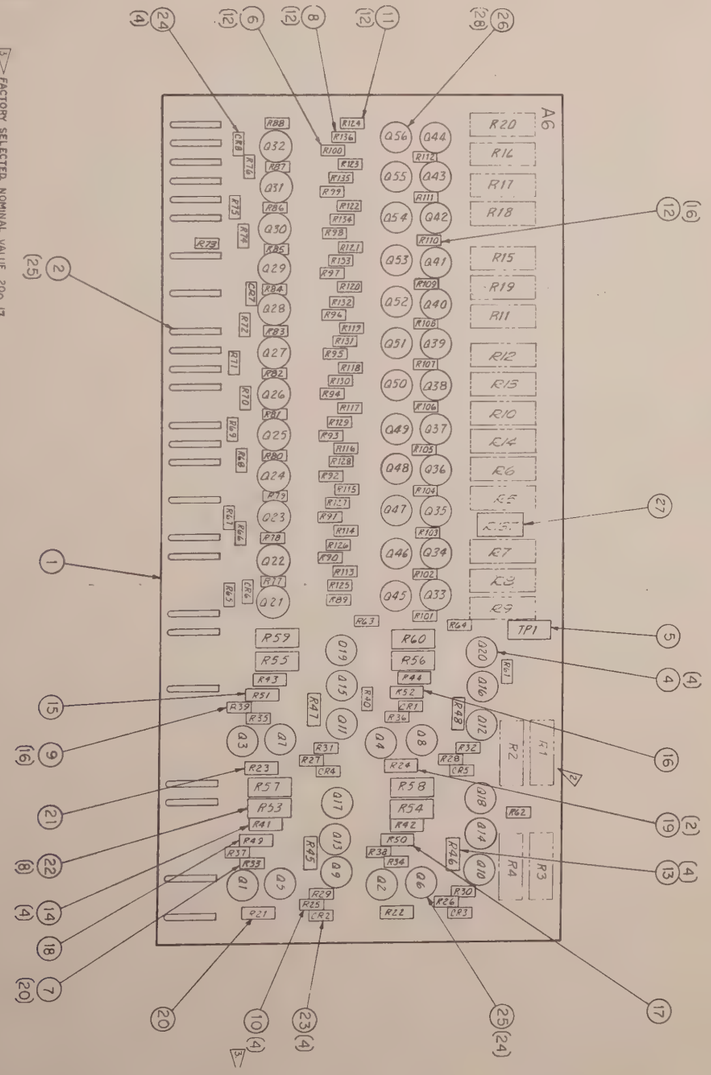
SUBASSEMBLY 66-6073

PARTS LIST

SUBASSEMBLY: Decoder **SCHEMATIC NO.:** 66-0773 **PART NO.:** 66-6073

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A6)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7073-3		15318
2	25	CONTACT–ELECT		2-63904	5001-1923	91662
3						
4	4	TRANSISTOR–SELECTED	Q17-Q20	66-0517-1		15318
5	1	TEST POINT JACK–BROWN	TP1	5-19004	TJ-51-4	82042
6	12	RES COMP 470	R89-R100	7-41239	RC07GF471J	MIL-R-11
7	20	RES COMP 2.2K	R33-R36,R29-R32,R77-R88	7-41247	RC07GF222J	MIL-R-11
8	12	RES COMP 3.3K	R125-R136	7-41249	RC07GF332J	MIL-R-11
9	16	RES COMP 4.7K	R37-R40,R65-R76	7-41251	RC07GF472J	MIL-R-11
10	4	RES COMP 22K	R25-R28	7-41259	RC07GF223J	MIL-R-11
11	12	RES COMP 100K	R113-R124	7-41267	RC07GF104J	MIL-R-11
12	16	RES COMP 1M	R101-R112, R61-R64	7-41279	RC07GF105J	MIL-R-11
13	4	RES TIN OXIDE 2.21K 1%	R45-R48	7-46710	RN60D2211F	MIL-R-10509
14	4	RES TIN OXIDE 3.01K 1%	R41-R44	7-46735	RN60D3011F	MIL-R-10509
15	1	RES TIN OXIDE 6.65K 1%	R51	7-46783	RN60D6651F	MIL-R-10509
16	1	RES TIN OXIDE 7.15K 1%	R52	7-46784	RN60D7151F	MIL-R-10509
17	1	RES TIN OXIDE 4.42K 1%	R50	7-46794	RN60D4421F	MIL-R-10509
18	1	RES TIN OXIDE 2.32K 1%	R49	7-46810	RN60D2321F	MIL-R-10509
19	2	RES TIN OXIDE 3.83K 1%	R22,R24	7-46813	RN60D3831F	MIL-R-10509
20	1	RES TIN OXIDE 3.92K 1%	R21	7-46753	RN60D3921F	MIL-R-10509
21	1	RES TIN OXIDE 4.12K 1%	R23	7-46818	RN60D4121F	MIL-R-10509
22	8	RES WW 0.56 5%	R53-R60	7-47225	RW69VR56	07716
23	4	SEMICOND DIODE	CR2-CR5	7-95647	1N914	JEDEC
24	4	SEMICOND DIODE	CR1,CR6-CR8	7-95671	1N4745A	JEDEC
25	24	TRANSISTOR	Q5-Q16,Q33-Q44	9-04003	2N2222	JEDEC
26	28	TRANSISTOR	Q1-Q4,Q21-Q32, Q45-Q56	9-04004	2N2907	JEDEC
27	1	RES WW 20 1%	R137	7-47325	1368P	07088

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



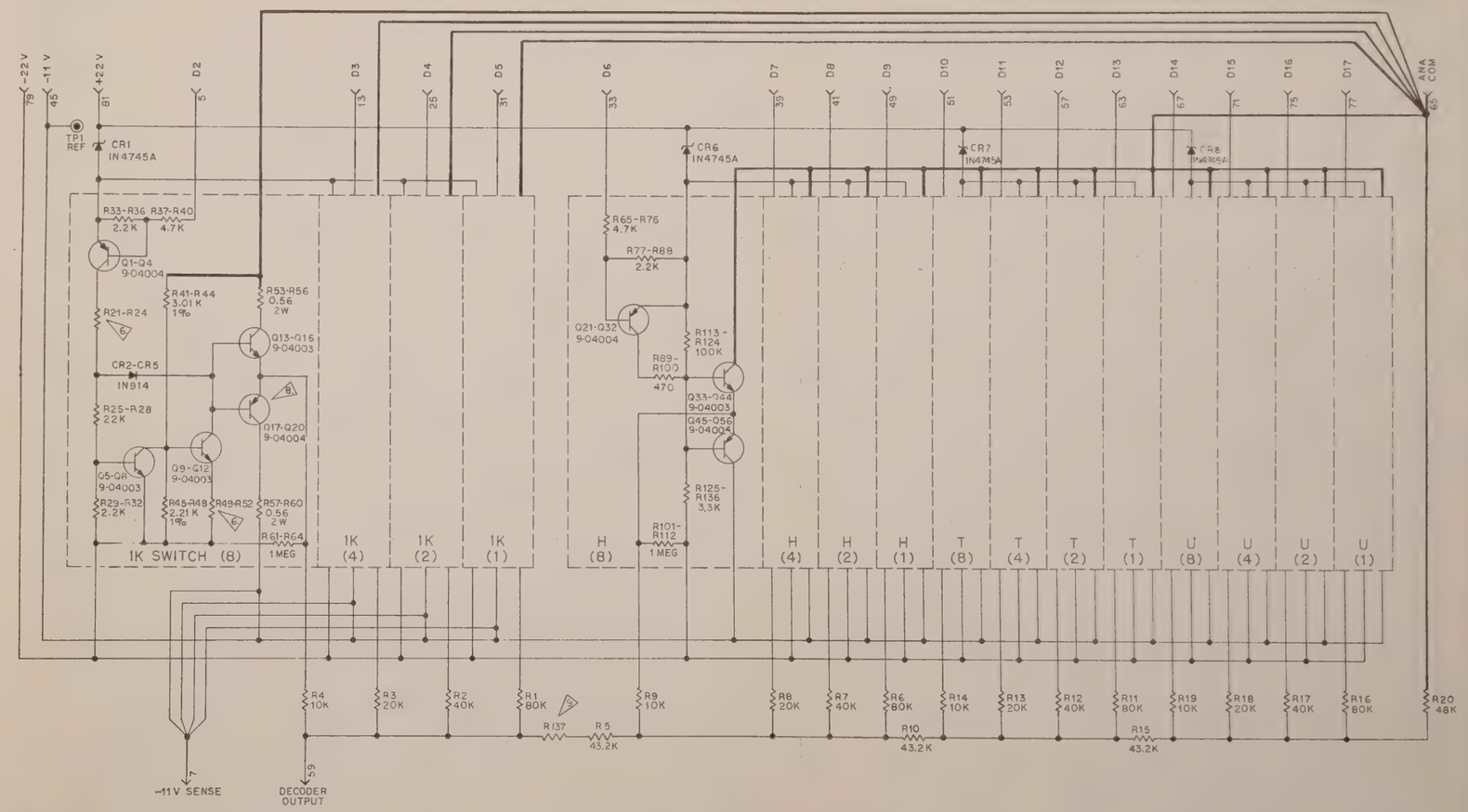
NOTES: UNLESS OTHERWISE SPECIFIED:

FACTORY SELECTED, NOMINAL VALUE 20Ω 1%

R1 THRU R20 ARE PART OF RESISTOR KIT NO. 66-0511-1, SEE DWG NO. 66-5004

PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COM-PLETE DESIGNATOR PREFIX A6

Figure 6-10. Decoder Subassembly.



3 FACTORY SELECTED, NOMINAL VALUE 20Ω 1%.

8 Q17 THRU Q20 ARE SELECTED VALUES PER 66-0517-1

9 SEE TABLE 1

NOTES: UNLESS OTHERWISE SPECIFIED:

5. R1 THRU R20 ARE COMPONENTS OF MATCHED SET NO. 66-0511-1
4. CR8, Q56, R137 | NONE
   LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A6
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

TABLE 1

INPUT	R21 THRU R24	R49 THRU R52
D2	3.92K	2.32K
D3	3.83K	4.42K
D4	4.12K	6.65K
D5	3.83K	7.15K

Diagram 8. Decoder Schematic.

REFERENCE AMPLIFIER

ASSEMBLY 66-6112

PARTS LIST

ASSEMBLY: Reference Amp			SCHEMATIC NO.: 66-0812		PART NO.: 66-6112	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A7)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD—ETCHED		66-7112-B		15318
2	1	DIFFERENTIAL AMPLIFIER	A1	0-05002-1		15318
3	1	CAP MET PAP 0.22 50V 10%	C3	1-57319	VX5A224K	12406
4	3	CAP MET PAP 0.1 50V 10%	C2,C5,C6	1-57321	VX5A104K	12406
5	1	CAP MET PAP 0.01 50V 10%	C1	1-57323	VX5A103K	12406
6	1	CAP -SELECTED VALUE	C4			
7	1	CAP CER DISC 0.1 10V	C8	1-57525	HY320	56289
8	33	CONTACT ELECT		2-63904	5001-1923	91662
9	3	REED RELAY	S1,S2,S3	7-38216	MR306-8	95348
10	2	RES COMP 1.8K 1/2W	R47,R46	7-41046	RC20GF182J	MIL-R-11
11	2	RES COMP 220	R43,R42	7-41235	RC07GF221J	MIL-R-11
12	1	RES COMP 1K	R25	7-41243	RC07GF102J	MIL-R-11
13	1	RES COMP 1.5K	R8	7-41245	RC07GF152J	MIL-R-11
14	9	RES COMP 2.7K	R12,R13,R50-56	7-41248	RC07GF272J	MIL-R-11
15	1	RES COMP 5.6K	R10	7-41252	RC07GF562J	MIL-R-11
16	1	RES COMP 12K	R45	7-41256	RC07GF123J	MIL-R-11
17	1	RES COMP 15K	R9	7-41257	RC07GF153J	MIL-R-11
18	1	RES COMP 27K	R11	7-41260	RC07GF273J	MIL-R-11
19	3	RES COMP 47K	R2,R36,R44	7-41263	RC07GF473J	MIL-R-11
20	2	RES COMP 3.6K	R57,R58	7-41300	RC07GF362J	MIL-R-11
21	2	RES TIN OXIDE 3.32K 1%	R34,R33	7-46704	RN60D3321F	MIL-R-10509
22	1	RES TIN OXIDE 10.2K 1%	R35	7-46757	RN60D1021F	MIL-R-10509
23	2	RES TIN OXIDE 221K 1%	R24,R27	7-46770	RN60D2213F	MIL-R-10509
24	1	RES TIN OXIDE 499K 1%	R29	7-46772	RN60D4993F	MIL-R-10509
25	1	RES TIN OXIDE 8.25K 1%	R23	7-46814	RN60D8251F	MIL-R-10509
26	1	RES TIN OXIDE 115K 1%	R26	7-46817	RN60D1153F	MIL-R-10509
27	3	RES WW 10K 0.1%	R18,R48,R49	7-47174	305A1369P	05347
28	2	RES WW 5K 1%	R37,R38	7-47190	OB H101	07088
29	1	RES WW 9.985K 0.1%	R19	7-47205	1368P	07088
30	1	RES WW 99.8K 0.1%	R6	7-47223	1368P	07088
31	1	RES WW 20K 0.01%	R3	7-47271	1368P	07088
32	1	RES WW 2K 1%	R7	7-47287	1368P	07088
33	1	RES WW 200K 0.05%	R28	7-47300	1368P	07088
34	1	RES WW 18.2K 0.05%	R17	7-47312	MK-3	17838
35	1	RES WW 19.5K 0.05%	R30	7-47327	1368P	07088

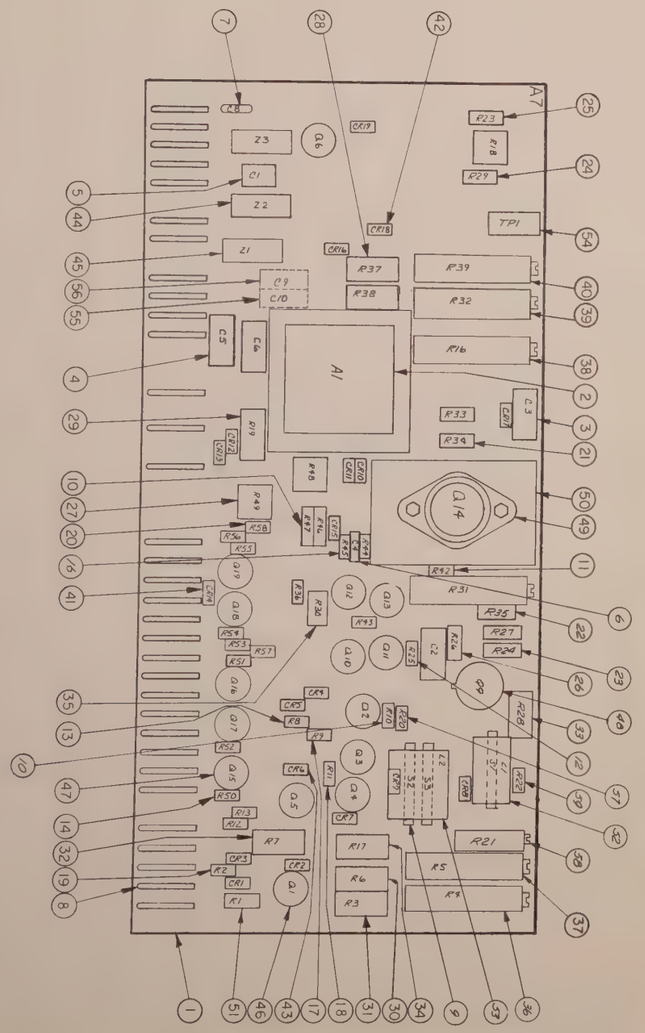
NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

ASSEMBLY: Reference Amp **SCHEMATIC NO.:** 66-0812 **PART NO.:** 66-6112

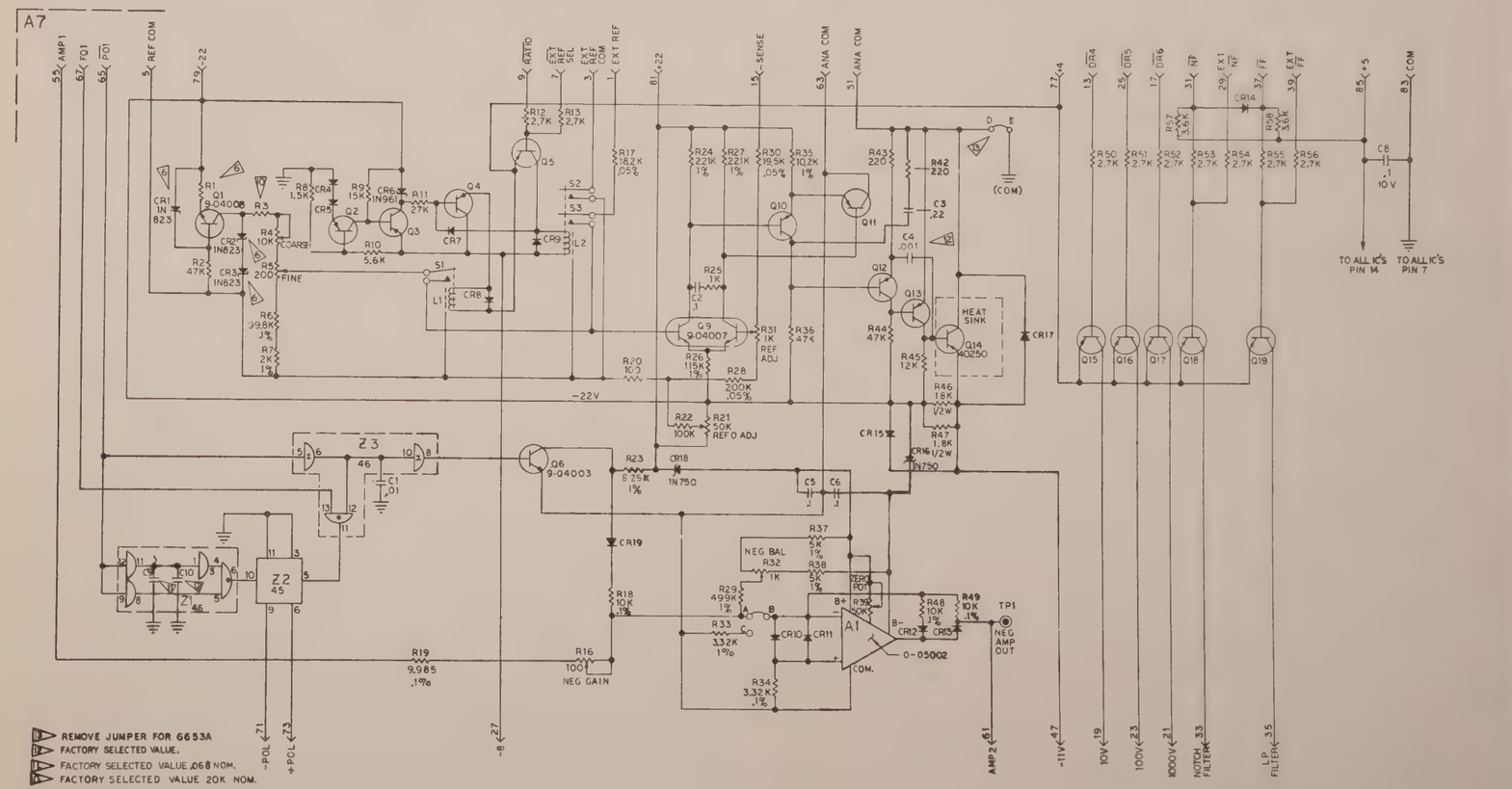
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A7)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
36	1	RES VAR TRIM WW 10K	R4	7-54103	275-1-103	80294
37	1	RES VAR TRIM WW 200	R5	7-54215	275-1-201	80294
38	1	RES VAR TRIM WW 100	R16	7-54238	1 PC	NONE
39	2	RES VAR TRIM WW 1K	R31,R32	7-54250	1 PC	NONE
40	1	RES MET FILM 50K	R39	7-54292	78PR50K	73138
41	13	SEMICOND DIODE	CR4,CR5,CR7–CR15,CR17,CR19	7-95647	1N914	JEDEC
42	2	SEMICOND ZENER	CR16,CR18	7-95608	1N750	JEDEC
43	1	SEMICOND ZENER	CR6	7-95653	1N961B	JEDEC
44	1	IC CLOCKED FLIP/FLOP	Z2	7-96007	MC845P	15873
45	2	IC QUAD 2 INPUT GATE	Z1,Z3	7-96008	MC846P	15873
46	2	TRANSISTOR	Q1,Q6	9-04003	2N2222	JEDEC
47	13	TRANSISTOR	Q2-Q5,Q10-Q13, Q15-Q19	9-04004	2N2907	JEDEC
48	1	TRANSISTOR	Q9	9-04007	2N2920	JEDEC
49	1	TRANSISTOR	Q14	9-04723	40250	49671
50	1	HEAT SINK		66-2116-1		15318
51	1	VOLTAGE REGULATOR GROUP	CR1,R1,CR2-3	66-5015-1		15318
52	1	COIL REED DRIVE	L1	80-0501-1		15318
53	1	COIL REED DRIVE	L2	90-0504-1		15318
54	1	TEST POINT–BROWN	TP1	5-19004	TJ-51-4	82042
55	1	CAP–SELECTED VALUE	C10			
56	1	CAP MET MY 0.068 50V 10%	C9	1-57322	VX5A683K	12406
57	1	RES COMP 100	R20	7-41231	RC07GF101J	MIL-R-11
58	1	RES VAR TRIM	R21	7-54283	ET34X100	30983
59	1	RES COMP 100K	R22	7-41267	RC07GF104J	MIL-R-11

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



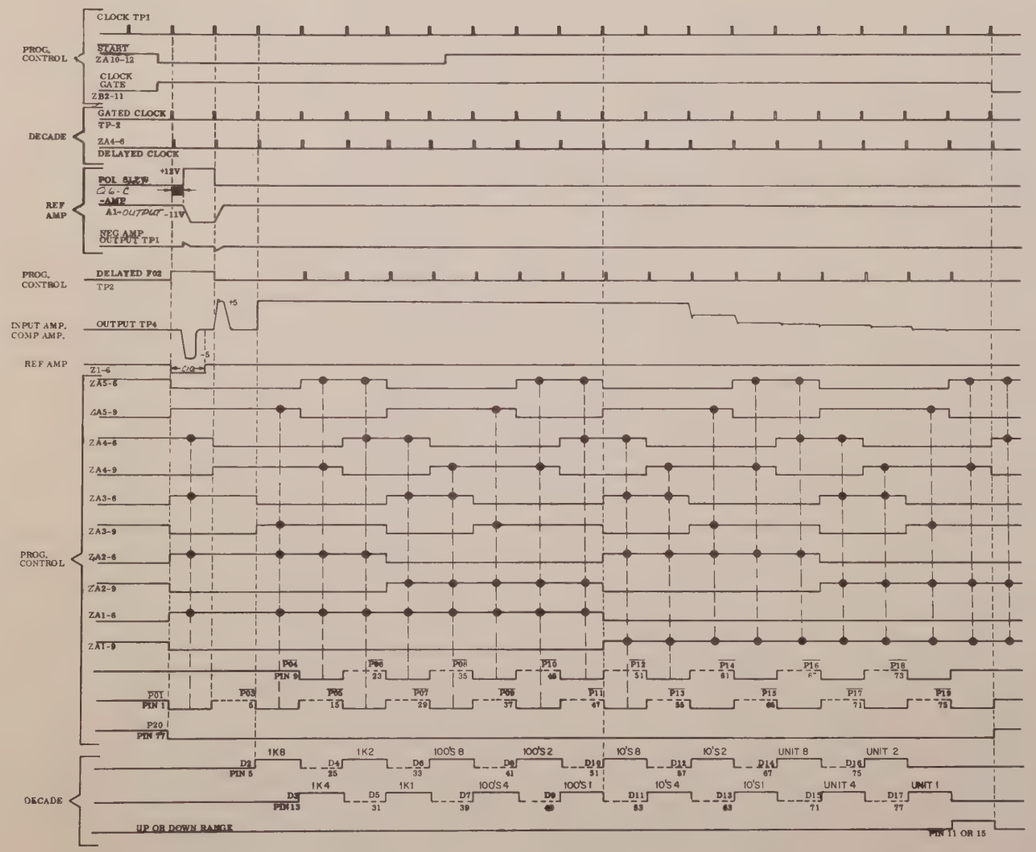
NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A7

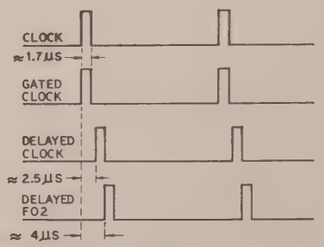
Figure 6-11. Reference Amplifier Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A7
4. C10, R56, CR13, Q19 ARE PART OF A1 ASSEMBLY. R40 R41, R14, R15, R20 LAST NUMBER USED | NUMBER NOT USED
5. TP1, A1, L2, S3 , R2, R22, Q7, Q8, C7
6. VOLTAGE REGULATOR GROUP 66-5015-1
7. ALL DIODES ARE 1N914
8. ALL TRANSISTORS ARE 9-04004

Diagram 9. Reference Amplifier Schematic.





ENLARGED TO SHOW TIME RELATIONSHIP

NOTES ◇

1. WAVEFORMS SHOWN ARE FOR ONE COMPLETE CONVERSION CYCLE WITH THE INPUT LEADS SHORTED AND +.0000 IN THE FRONT PANEL INDICATION.
2. THE LONG-DASHED LINES FROM EACH PROGRAM PULSE INDICATES WHICH FLIP-FLOPS(ZA1-ZA5) ARE DECODED TO PRODUCE THE PROGRAM PULSE.
3. $\overline{P01}$ THRU $\overline{P19}$ ARE SHOWN ON TWO LINES FOR CONVENIENCE.
4. D2 THRU D17 ARE SHOWN ON TWO LINES FOR CONVENIENCE.

Diagram 10. Conversion Timing Sequence.

DISPLAY DRIVER NO. 2

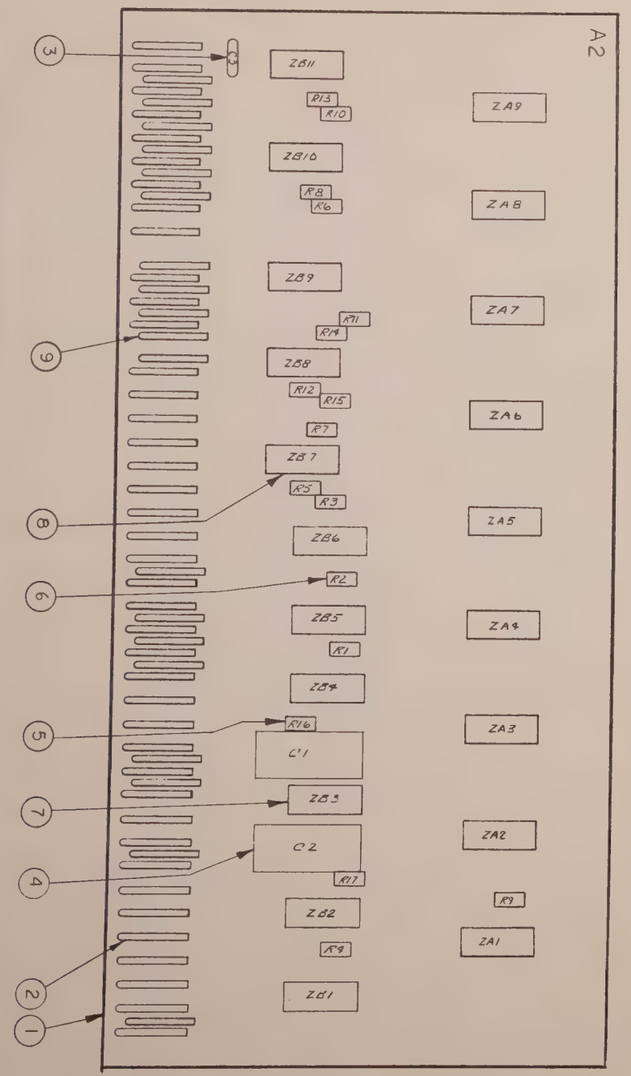
ASSEMBLY 66-6118

PARTS LIST

ASSEMBLY: Display Driver No. 2 **SCHEMATIC NO.:** 66-0818 **PART NO.:** 66-6118

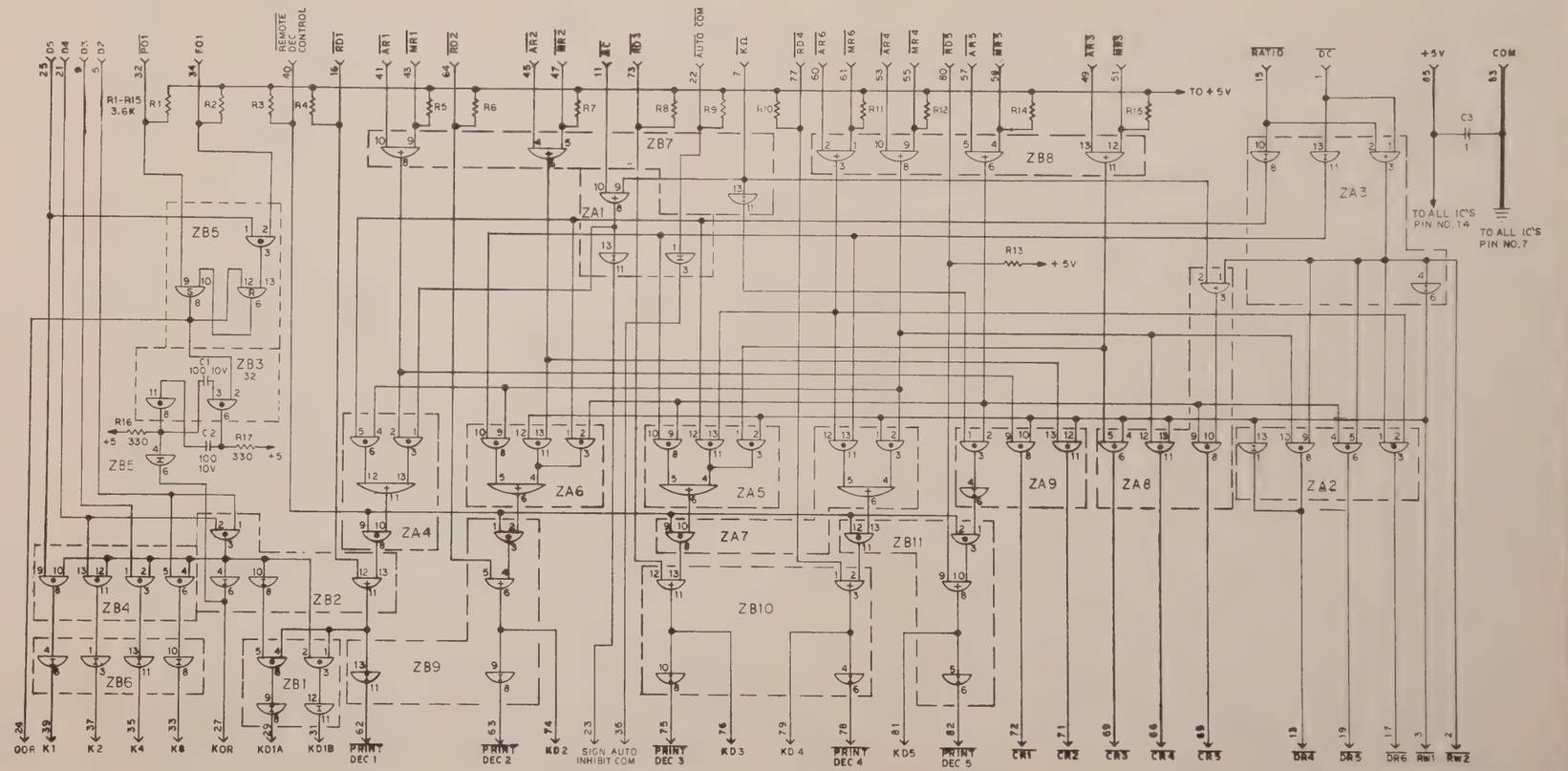
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A2)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7118-B		15318
2	41	CONTACT–ELECT		2-63904	5001-1923	91662
3	1	CAP CER DISC 0.1 10V	C3	1-57525	HY320	56289
4	2	CAP ELECT 100 10V	C1,C2	1-59006	107G010KD4	56289
5	2	RES COMP 330	R16,R17	7-41237	RC07GF331J	MIL-R-11
6	15	RES COMP 3.6K	R1-R15	7-41300	RC07GF362J	MIL-R-11
7	1	IC DUAL BUFFER	ZB3	7-96004	MC832P	15873
8	19	IC QUAD 2 INPUT GATE	ZA1-ZA9,ZB1, ZB2,ZB4-ZB11	7-96008	MC846P	15873
9	19	CONTACT ELECT		2-63907	7001-0523	91662

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A2

Figure 6-12. Display Driver No. 2 Assembly.



5. IC'S ARE 46
4. R17, C3, ZA9, ZB11 | NONE
   LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A2
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

NOTES: UNLESS OTHERWISE SPECIFIED:

Diagram 11. Display Driver No. 2 Schematic.

LIGHT

SUBASSEMBLY 66-6077

AND

DISPLAY DRIVER NO. 1

ASSEMBLY 66-6075

PARTS LIST

SUBASSEMBLY: Light SCHEMATIC NO.: 66-0777 PART NO.: 66-6077

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX B1)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7077-1		15318
2	25	CONTACT ELECT–LOWER		2-63904	5001-1923	91662
3	26	CONTACT ELECT–UPPER		2-63907	7001-0523	91662
4	2	BRACKET–BD MTG		66-2122-1		15318
5	5	ELECTRON TUBE–NUMERAL	DS2-DS6	3-41408	B5441	92379
6	1	ELECTRON TUBE–POLARITY	DS1	3-41409	B5442	92379
7	6	RES COMP 1/2W 27K	R1,R3,R5-R8	7-41060	RC20GF273J	MIL-R-11
8	1	RES COMP 1/2W 68K	R4	7-41065	RC20GF683J	MIL-R-11
9	1	RES COMP 100K	R2	7-41267	RC07GF104J	MIL-R-11
10	6	SOCKET–ELECTRON TUBE		8-24003	SK196	92379

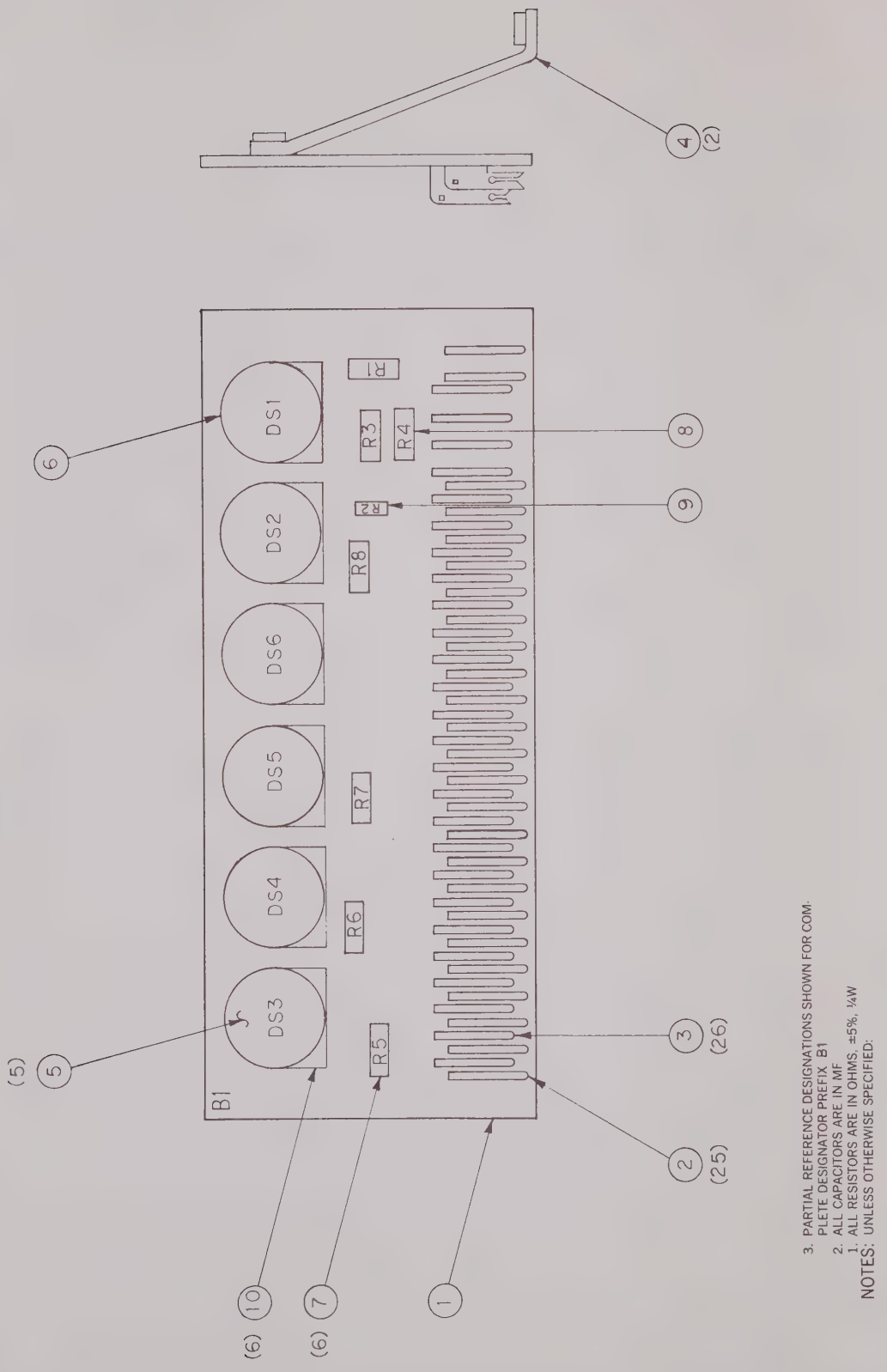
NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

ASSEMBLY: Display Driver No. 1 **SCHEMATIC NO.:** 66-0775 **PART NO.:** 66-6075

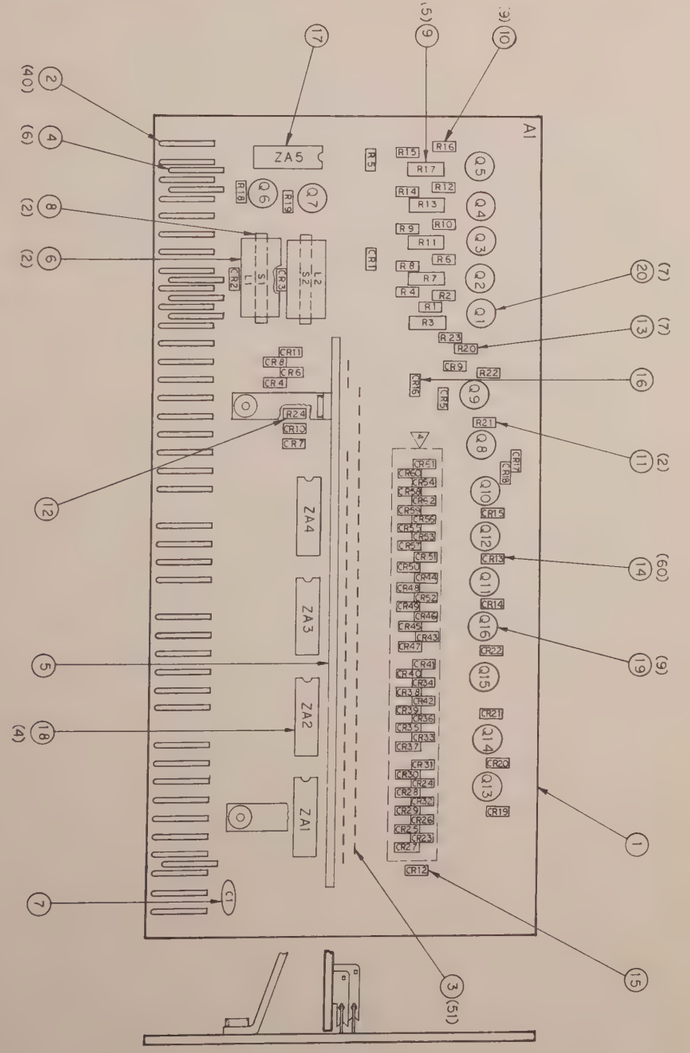
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A1)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7075-1		15318
2	40	CONTACT ELECT–LOWER		2-63904	5001-1923	91662
3	51	CONTACT–ELECT		2-63905	5201-0223	91662
4	6	CONTACT ELECT–UPPER		2-63907	7001-0523	91662
5	1	LIGHT SUBASSEMBLY		66-6077-3		15318
6	2	COIL REED DRIVE	L1, L2	70-0511-1		15318
7	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
8	2	REED RELAY	S1,S2	7-38216	MR306-8	95348
9	5	RES COMP 1/2W 27	R3,R7,R11,R13, R17	7-41024	RC20GF270J	MIL-R-11
10	9	RES COMP 1K	R1,R2,R5,R6, R10,R12,R16, R18,R19	7-41243	RC07GF102J	MIL-R-11
11	2	RES COMP 2.7K	R21,R22	7-41248	RC07GF272J	MIL-R-11
12	1	RES COMP 100K	R24	7-41267	RC07GF104J	MIL-R-11
13	7	RES COMP 3.6K	R4,R8,R9,R14, R15,R20,R23	7-41300	RC07GF362J	MIL-R-11
14	60	SEMICOND DIODE	CR1-CR11,CR13-CR15,CR17-CR62	7-95647	1N914	JEDEC
15	1	SEMICOND DIODE ZENER	CR12	7-95661	1N732A	JEDEC
16	1	SEMICOND DIODE ZENER	CR16	7-95674	1N985	JEDEC
17	1	INTEGRATED CIRCUIT	ZA5	7-96008	MC846P	15873
18	4	INTEGRATED CIRCUIT	ZA1-ZA4	7-96032	SN7441AN	01295
19	9	TRANSISTOR	Q8-Q16	9-04005	2N3114	JEDEC
20	7	TRANSISTOR	Q1-Q7	9-04004	2N2907	JEDEC
21	2	BRACKET NIXIE BD MTG		66-2122-1		15318

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



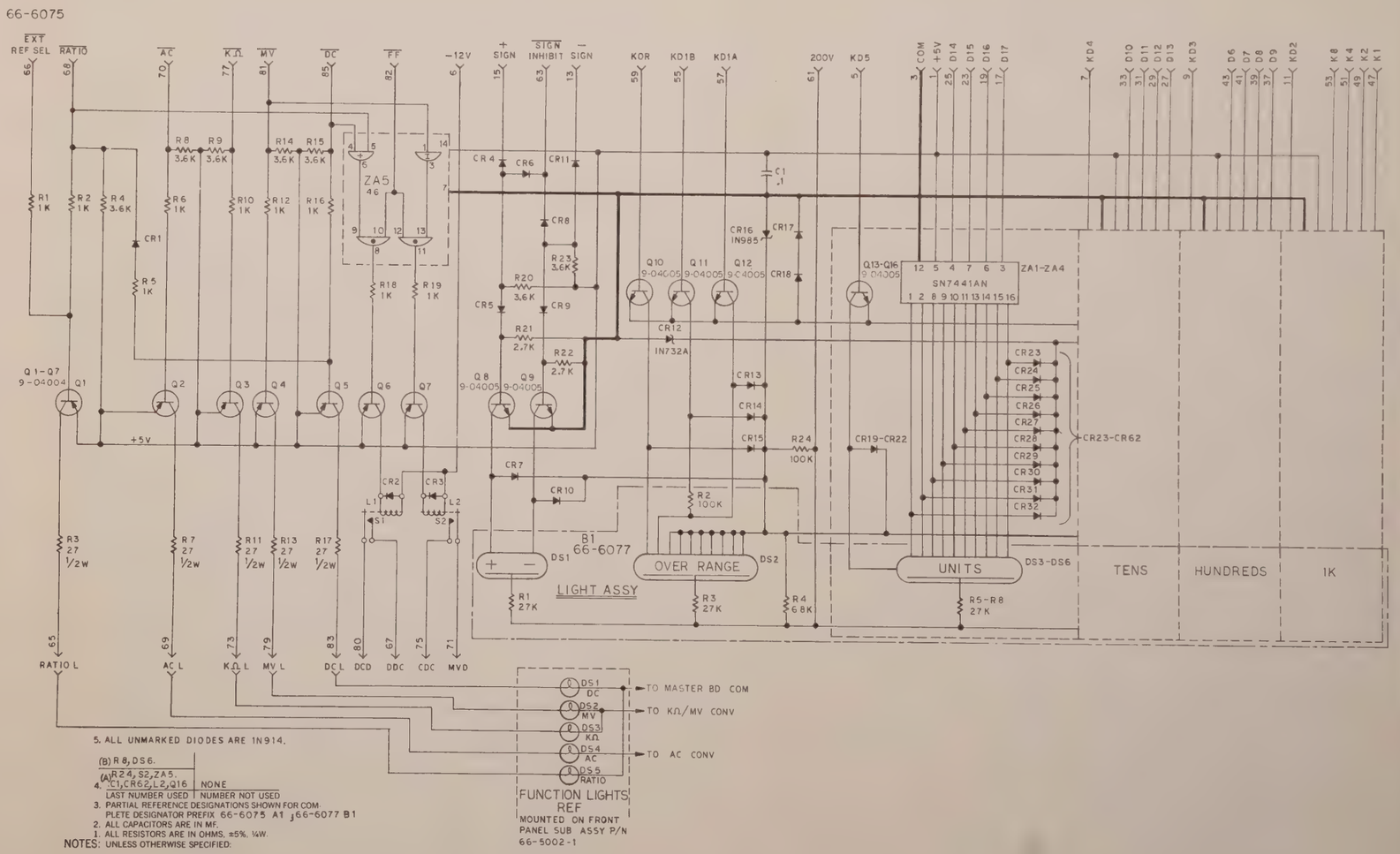
NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX B1

Figure 6-13. Light Subassembly.



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A1
4. CR23 - CR62 USED ONLY WITH INTEGRATED CIRCUIT PC BOARD ASSY P/N 66-6075

Figure 6-14. Display Driver No. 1 Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W.
2. ALL CAPACITORS ARE IN MF.
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX 66-6075 A1 ; 66-6077 B1
4. (A) C1, CR62, L2, Q16 — LAST NUMBER USED; (B) R24, S2, ZA5 — NUMBER NOT USED: NONE
5. ALL UNMARKED DIODES ARE 1N914.

Diagram 12. Display Driver No. 1 Schematic.

AUTORANGE

ASSEMBLY 66-6119

PARTS LIST

ASSEMBLY: Autorange SCHEMATIC NO.: 66-0819 PART NO.: 66-6119

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A3)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7119-1		15318
2	19	CONTACT–ELECT		2-63904	5001-1923	91662
3	4	CAP TANT 2.2 10% 20V	C4-C7	1-57108	150D225X90-20A2	56289
4	1	CAP TANT 10 10% 20V	C1	1-57112	150D106X90-20B2	56289
5	2	CAP MET PAP 0.22 10% 50V	C2,C8	1-57319	VX5A224K	12406
6	1	CAP MET PAP 0.068 10% 50V	C10	1-57322	VX5A683K	12406
7	1	CAP MET PAP 0.033 10% 50V	C3	1-57330	VX5A333K	12406
8	1	CAP MET PAP 0.015 10% 50V	C9	1-57329	VX5A153K	12406
9	2	CAP CER DISC 0.1 10V	C11,C12	1-57525	HY320	56289
10	1	TEST JACK–RED	TP2	5-19002	TJ-51-2	82042
11	1	TEST JACK–BROWN	TP1	5-19004	TJ-51-4	82042
12	1	RES COMP 180	R3	7-41234	RC07GF181J	MIL-R-11
13	1	RES COMP 330	R2	7-41237	RC07GF331J	MIL-R-11
14	4	RES COMP 3.6K	R1,R4,R6,R8	7-41300	RC07GF362J	MIL-R-11
15	2	DUAL BUFFER–4 INPUT	ZB10,ZB13	7-96004	MC832P	15873
16	7	CLOCK FLIP/FLOP	ZB3-ZB9	7-96007	MC845P	15873
17	15	QUAD–2 INPUT GATE	ZA1-ZA7, ZB12, ZA9-ZA12, ZB1-ZB2,ZB11	7-96008	MC846P	15873
18	1	TRIPLE, 3 INPUT gATE	ZA8	7-96010	MC862P	15873
19	1	RES COMP 100K	R7	7-41267	RC07GF104J	MIL-R-11
20	1	RES COMP 1K	R5	7-41243	RC07GF102J	MIL-R-11
21	1	CAP TANT 4.7 10% 35V	C13	1-57113	150D475X90-35B2	56289
22	2	TRANSISTOR	Q1,Q2	9-04003	2N2222	JEDEC

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A3

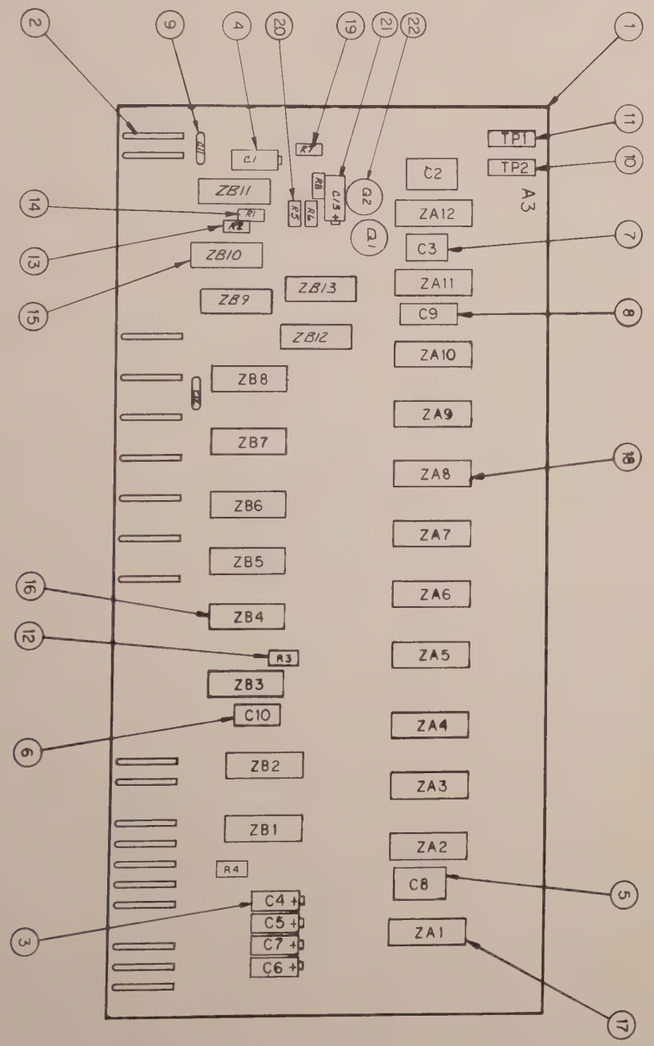
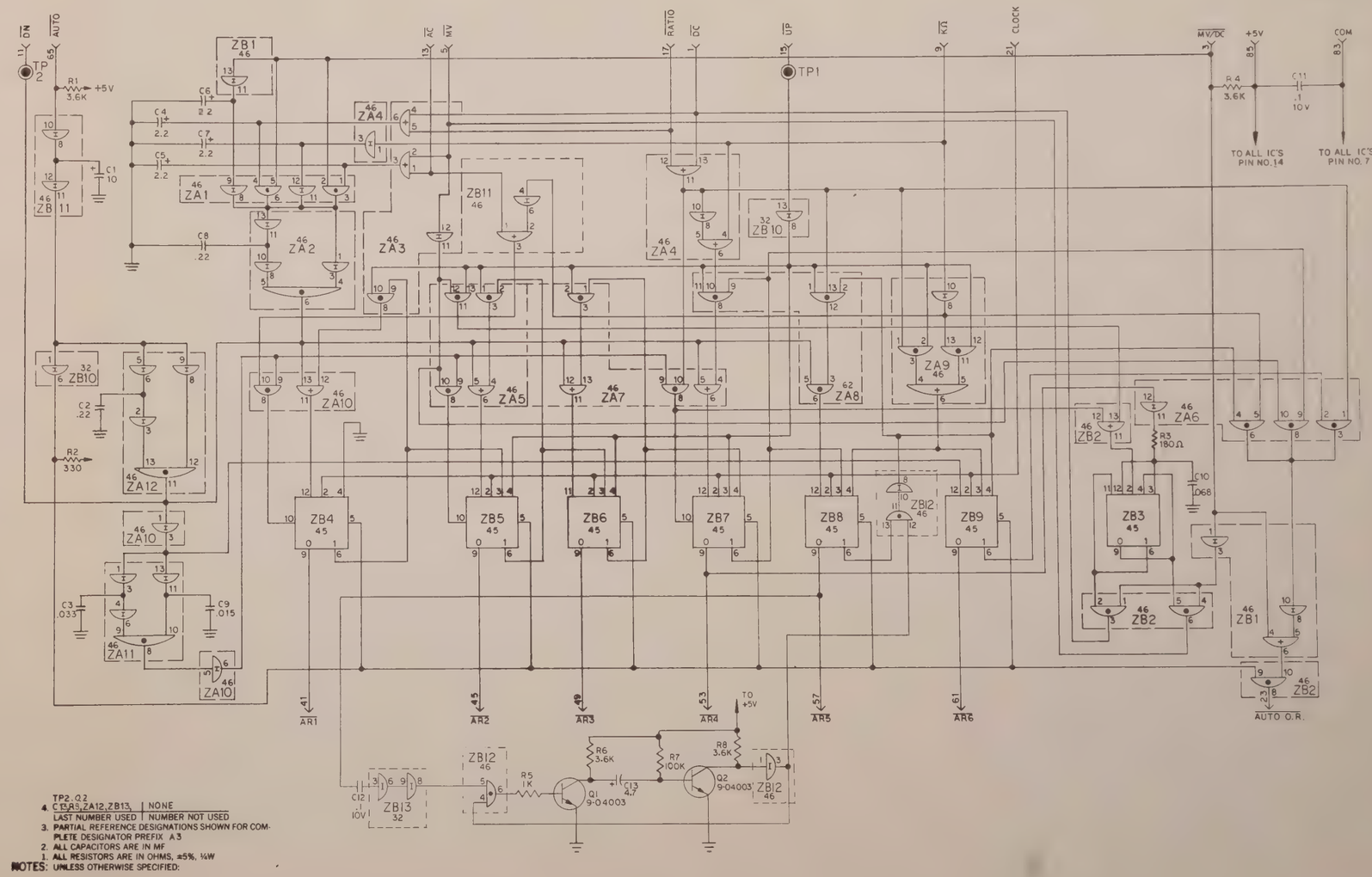


Figure 6-15. Autorange Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A3
4. C15,18,ZA12,ZB13, | NONE
LAST NUMBER USED | NUMBER NOT USED
TP2, Q2

Diagram 13. Autorange Schematic.

PRINT CONTROL

ASSEMBLY 66-6137

PARTS LIST

ASSEMBLY:	Print Control	SCHEMATIC NO.:	66-0837	PART NO.:	66-6137

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A12)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7137-F		15318
2	25	CONTACT–ELECT		2-63904	5001-1923	91662
3	9	CONTACT–ELECT		2-63907	7001-0523	91662
4	1	CAP TANT 0.47 35V	C13	1-57111	CS13BF474K	06751
5	2	CAP TANT 10	C1,C6	1-57112	150D106X90-20B2	56289
6	3	CAP TANT 4.7 35V	C3,C4,C11	1-57113	150D475X90-35B2	56289
7	1	CAP TANT 6.8 10% 35V	C8	1-57114	150D685X90-35B2	56289
8	1	CAP TANT 1 20V	C7	1-57119	CS13BF105K	06751
9	1	CAP MET PAP 0.33 50V	C9	1-57328	VX5A334J	12406
10	1	CAP MET PAP 0.015 50V	C12	1-57329	VX5A153K	12406
11	2	CAP MET PAP 0.0033	C2,C10	1-57368	4M332K	96733
12	1	CAP SIL MICA 300 pF	C14	1-57478	CM15E301J	04062
13	1	CAP CER DISC 0.1 10V	C5	1-57525	HY320	56289
14	1	REED RELAY	S1	7-38216	MR306-8	95348
15	1	RES COMP 22	R17	7-41223	RC07GF220J	MIL-R-11
16	1	RES COMP 100	R14	7-41231	RC07GF101J	MIL-R-11
17	9	RES COMP 1K	R1,R19,R25,R26, R28,R29,R32,R33, R34	7-41243	RC07GF102J	MIL-R-11
18	4	RES COMP 2.2K	R10,R18,R21,R22	7-41247	RC07GF222J	MIL-R-11
19	1	RES COMP 3.3K	R9	7-41249	RC07GF332J	MIL-R-11
20	2	RES COMP 3.9K	R11,R24	7-41250	RC07GF392J	MIL-R-11
21	2	RES COMP 5.6K	R20,R23	7-41252	RC07GF562J	MIL-R-11
22	2	RES COMP 8.2K	R27,R30	7-41254	RC07GF822J	MIL-R-11
23	1	RES COMP 10K	R31	7-41255	RC07GF103J	MIL-R-11
24	5	RES COMP 3.6K	R2-R5,R13	7-41300	RC07GF362J	MIL-R-11
25	4	RES VAR TRIM 100K	R8,R12,R15,R16	7-54262	78PR100K	73138
26	1	RES VAR TRIM 200K	R7	7-54263	78PR200K	73138
27	4	SEMICOND DIODE	CR1, CR4	7-95647	1N914	JEDEC
28	1	IC DUAL 4 INPUT GATE	ZB4	7-96002	MC830P	15873
29	1	IC DUAL BUFFER	ZC2	7-96004	MC832P	15873
30	2	IC CLOCKED FLIP/FLOP	ZA1,ZA2	7-96007	MC845P	15873

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

ASSEMBLY: Print Control			SCHEMATIC NO.: 66-0837		PART NO.: 66-6137	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A12)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
31	14	IC QUAD 2 INPUT GATE	ZA3,ZA4,ZB1-ZB3, ZB5,ZB7,ZB8,ZC1, ZC3,ZC5,ZC7,ZC8	7-96008	MC846P	15873
32	2	IC TRIPLE 3 INPUT GATE	ZC6,ZB6	7-96010	MC862P	15873
33	1	UNIJUNCTION	Q3	9-04402	2N4852	15873
34	6	TRANSISTOR	Q1,Q2,Q4-Q7	9-04003	2N2222	JEDEC
35	1	TRANSISTOR	Q8	9-04004	2N2907	JEDEC
36	1	COIL REED DRIVE	L1	90-0504-1		15318
37	1	RES COMP 4.7K	R6	7-41251	RC07GF472J	MIL-R-11

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

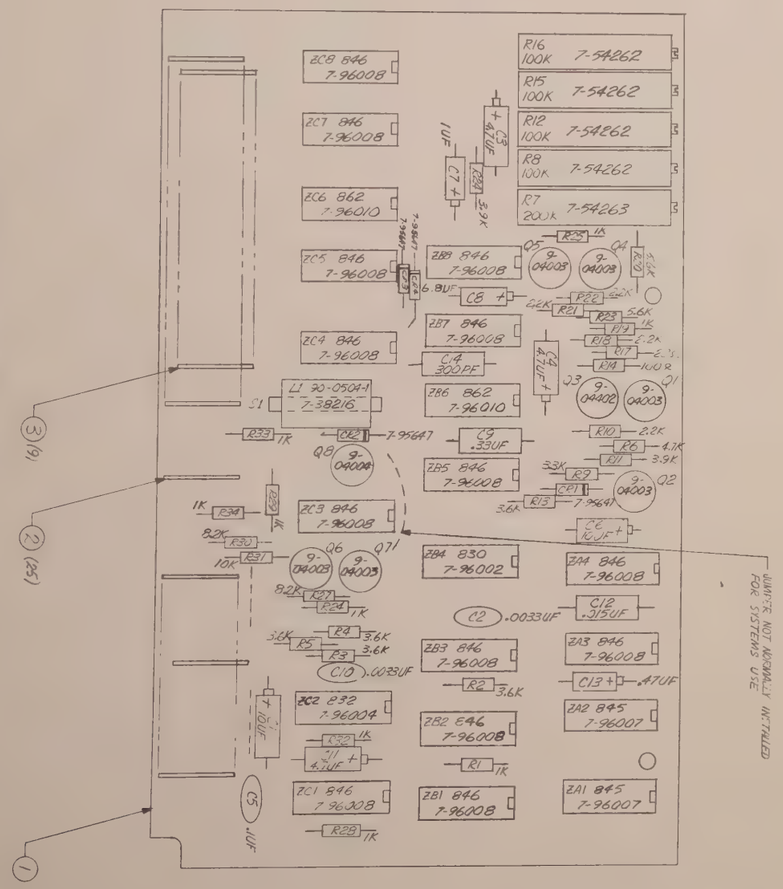


Figure 6-16. Print Control Assembly.

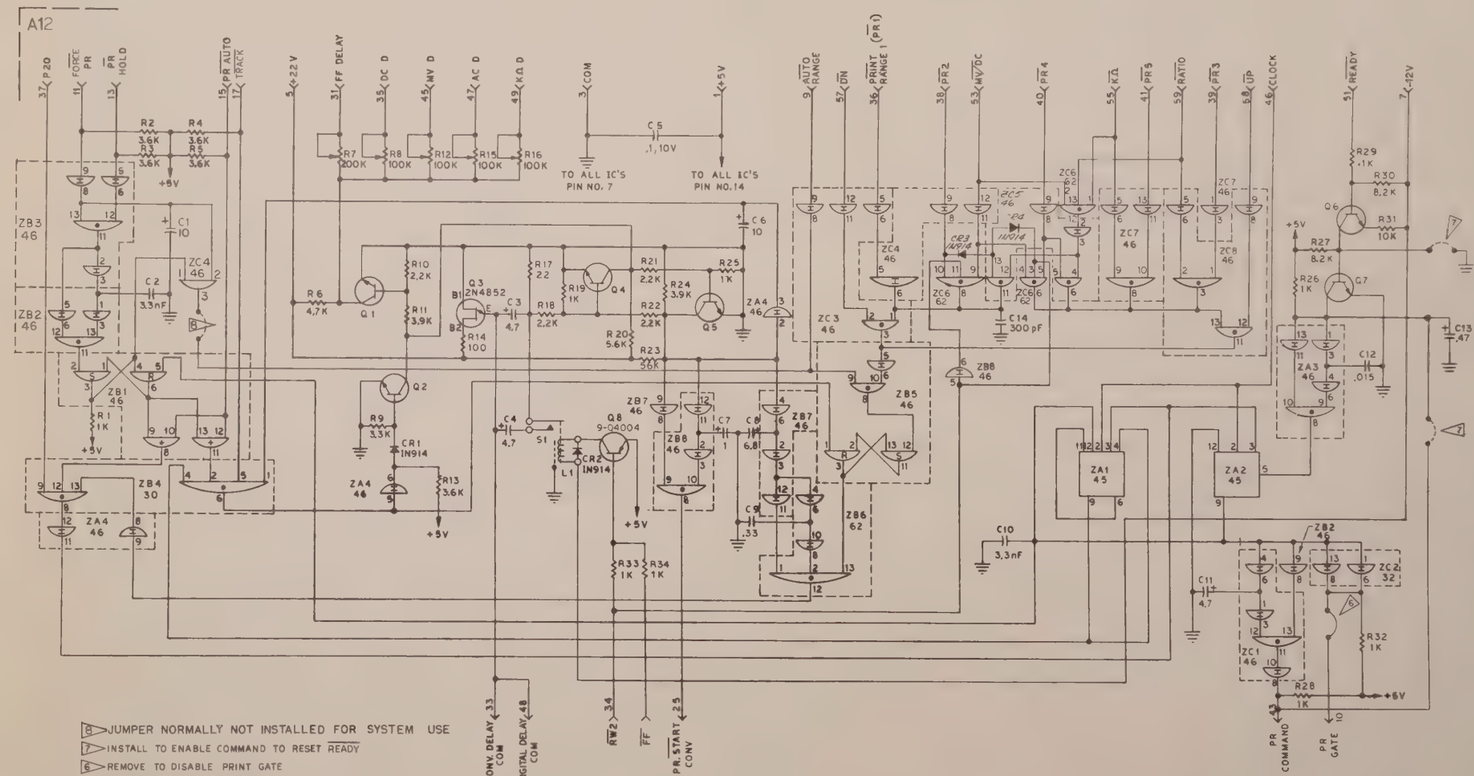
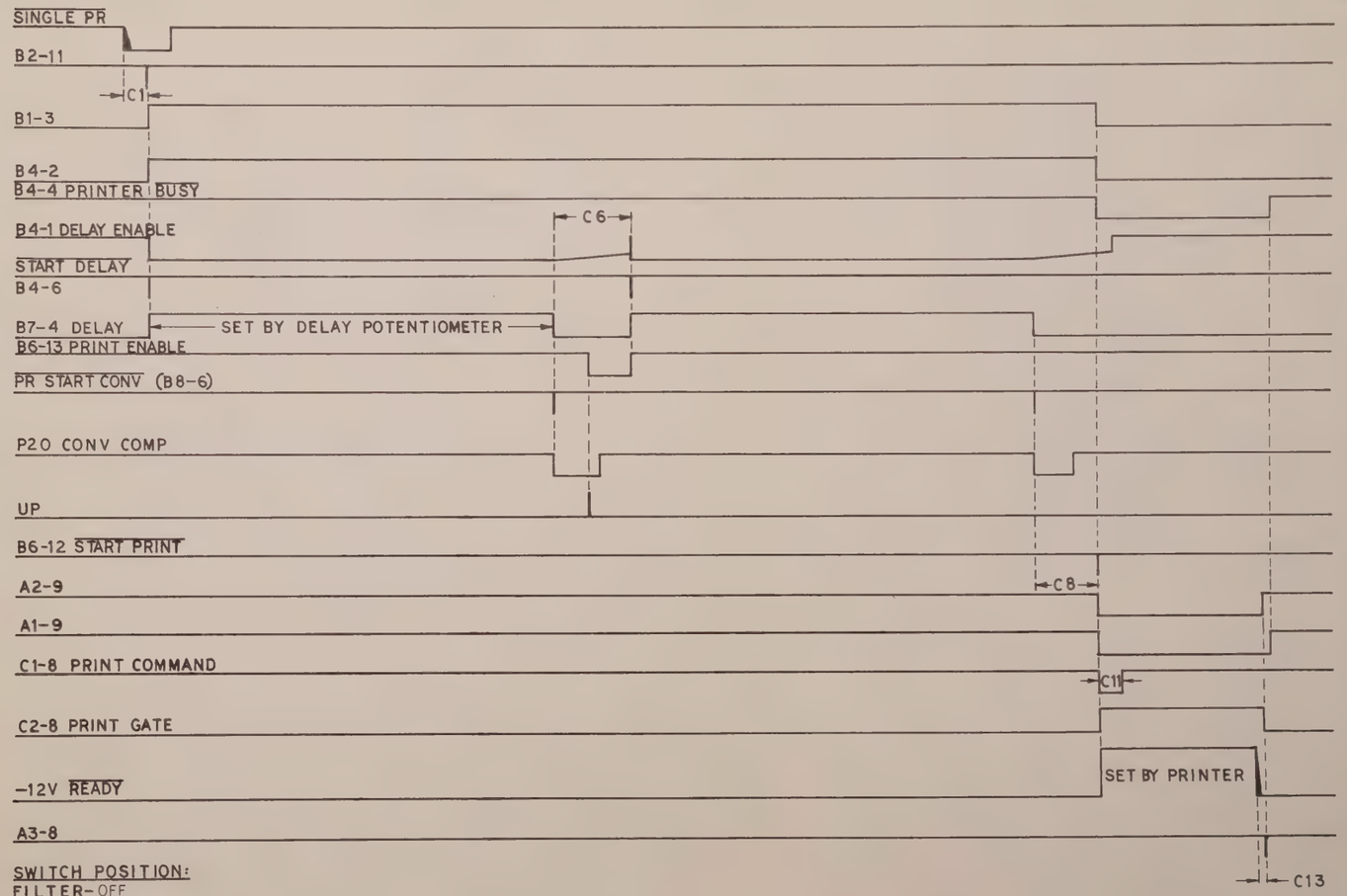


Diagram 14. Print Control Schematic.



SWITCH POSITION:
FILTER-OFF
FUNCTION-KΩ
RANGE-AUTO
PRINT-HOLD

MEASURING 7.5KΩ
THE PREVIOUS READING WAS .0000
DEPRESS PRINT/FORCE

Diagram 15. Print Timing.

DTL PRINT OUTPUT NO. 1

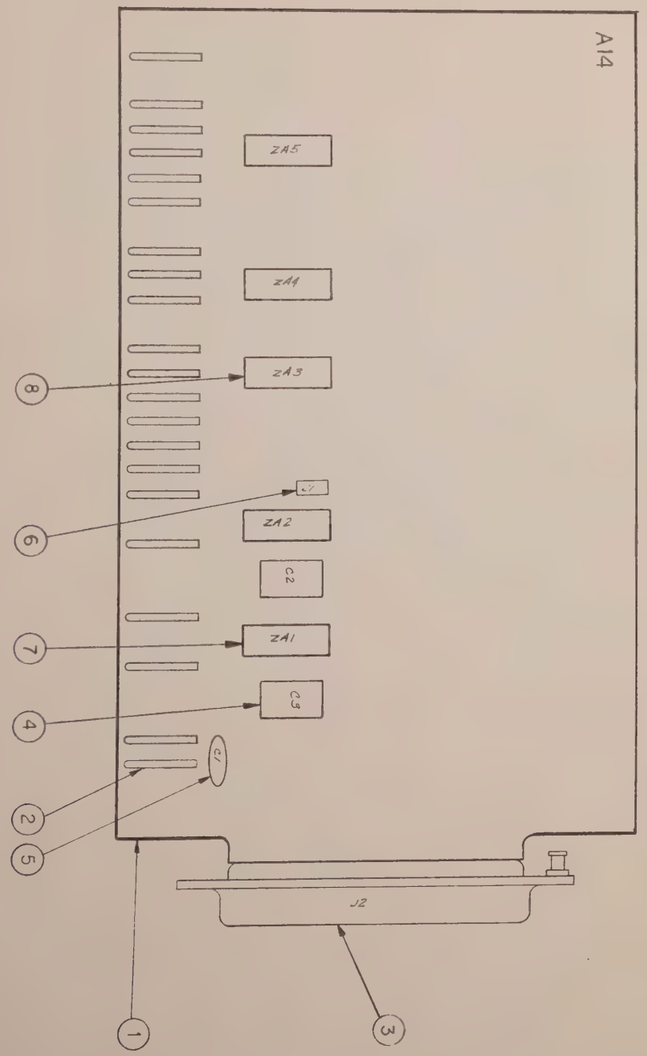
ASSEMBLY 66-6126

PARTS LIST

ASSEMBLY:	DTL Print Output No.1	SCHEMATIC NO.:	66-0826	PART NO.:	66-6126

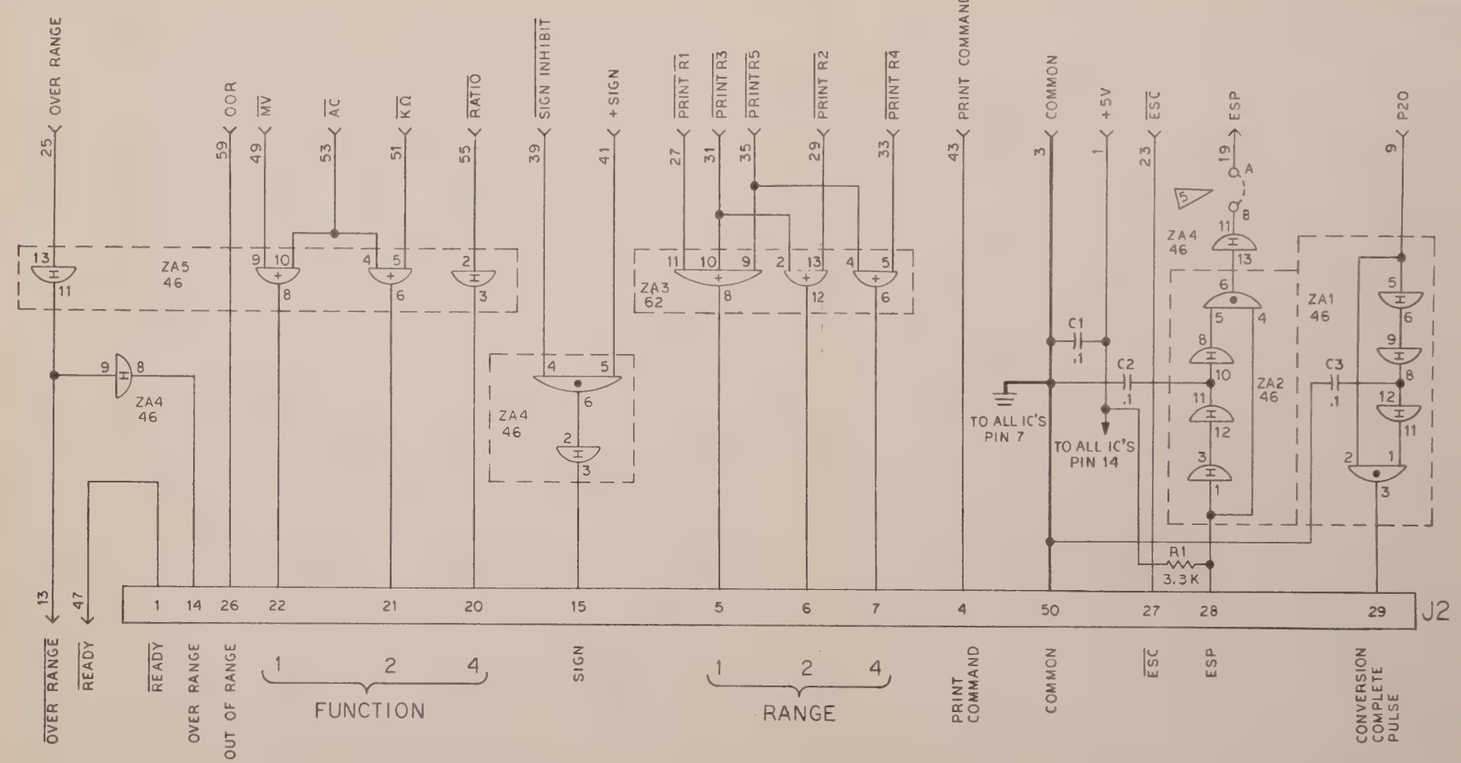
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A14)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7126-3		15318
2	21	CONTACT–ELECT		2-63904	5001-1923	91662
3	1	CONN 50 PIN MIN	J2	67-0518-1		15318
4	2	CAP MET PAP 0.1 10% 50V	C2,C3	1-57321	VX5A104K	12406
5	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
6	1	RES COMP 3.3K	R1	7-41249	RC07GF332J	MIL-R-11
7	4	IC QUAD 2 INPUT GATE	ZA1,ZA2,ZA4, ZA5	7-96008	MC846P	15873
8	1	IC TRIPLE 3 INPUT GATE	ZA3	7-96010	MC862P	15873

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A14

Figure 6-17. DTL Print Output No. 1 Assembly.



5 OPTION
REMOVE JUMPER WHEN USING REMOTE NO. 1

4. ZA5, C3, R1, J2 | J1
   LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

NOTES: UNLESS OTHERWISE SPECIFIED:

Diagram 16. DTL Print Output No. 1 Schematic.

DTL PRINT OUTPUT NO. 2

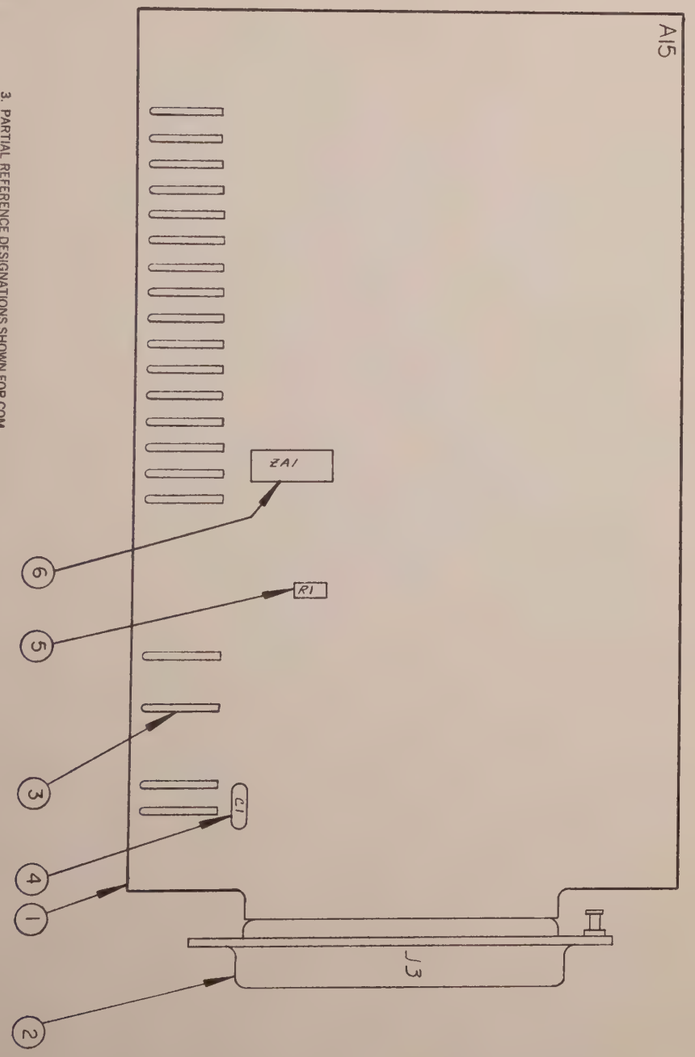
ASSEMBLY 66-6127

PARTS LIST

ASSEMBLY: DTL Print Output No. 2 **SCHEMATIC NO.:** 66-0827 **PART NO.:** 66-6127

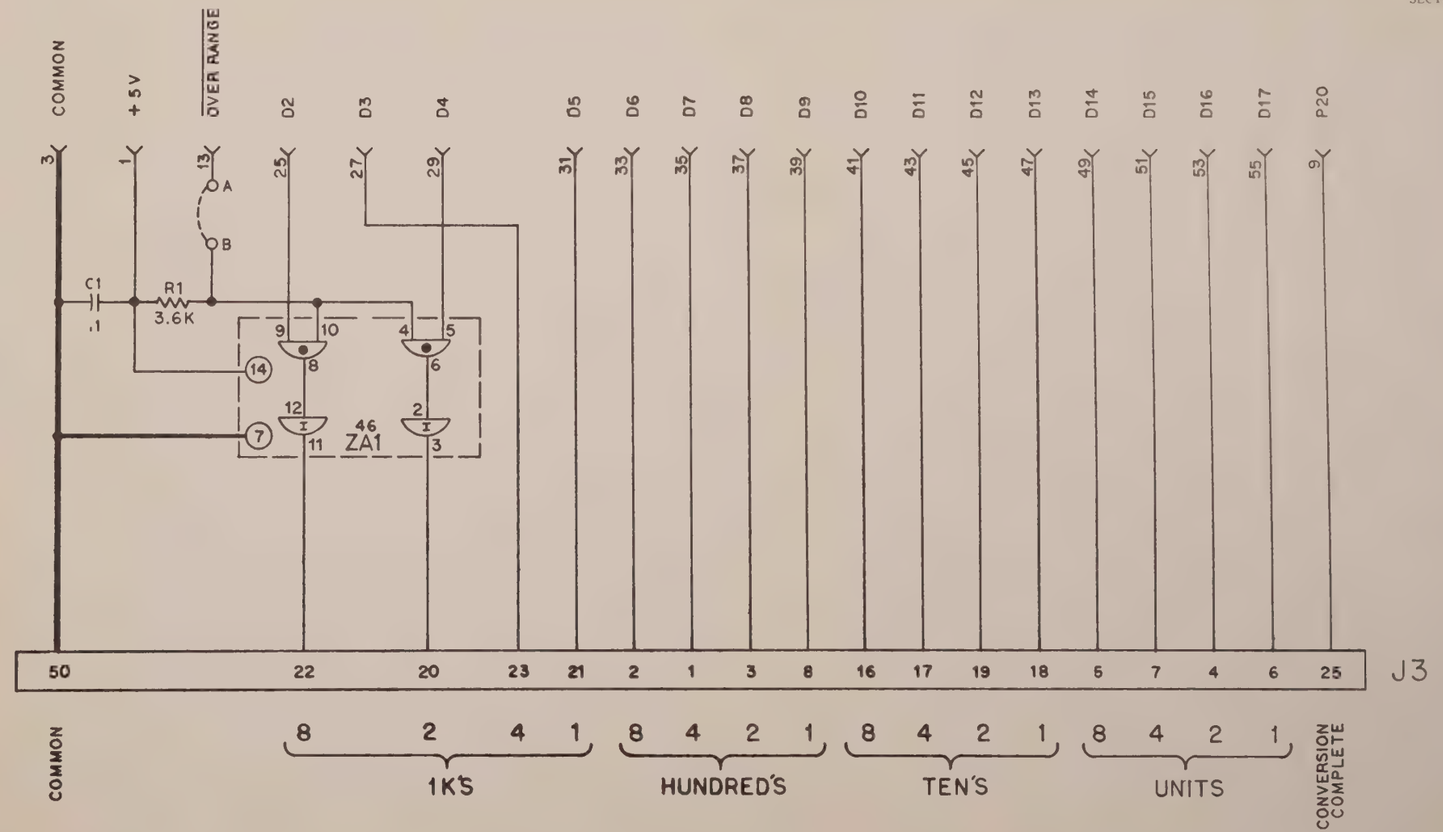
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A15)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7127-1		15318
2	1	CONNECTOR 50 PIN MIN	J3	67-0518-1		15318
3	20	CONTACT ELECT		2-63904	5001-1923	91662
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	1	RES COMP 3.6K	R1	7-41300	RC07GF362J	MIL-R-11
6	1	IC QUAD 2 INPUT GATE	ZA1	7-96008	MC846	15873

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A15
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

Figure 6-18. DTL Print Output No. 2 Assembly.



4. R1, ZA1, C1, J3 | J1 & J2
   LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A15
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

NOTES: UNLESS OTHERWISE SPECIFIED:

Diagram 17. DTL Print Output No. 2 Schematic.

BCD VOLTAGE STATE NO. 1 (-12)

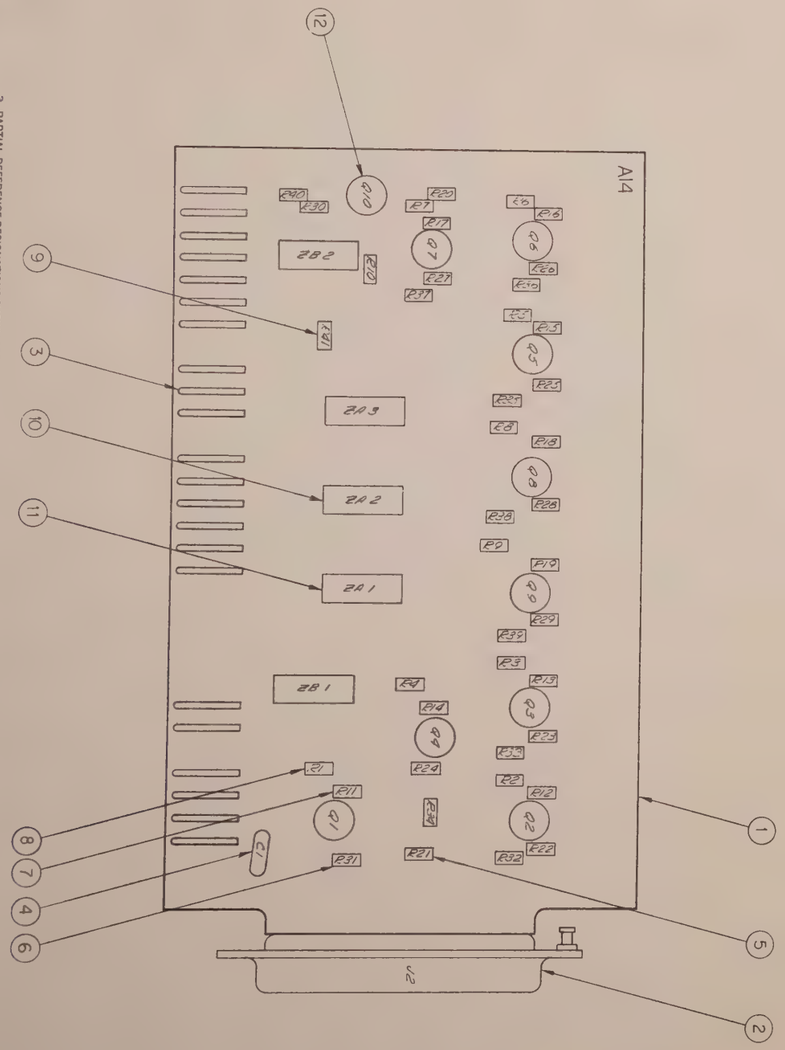
ASSEMBLY 66-6128

PARTS LIST

ASSEMBLY: BCD Voltage State No. 1 (-12) **SCHEMATIC NO.:** 66-0828 **PART NO.:** 66-6128

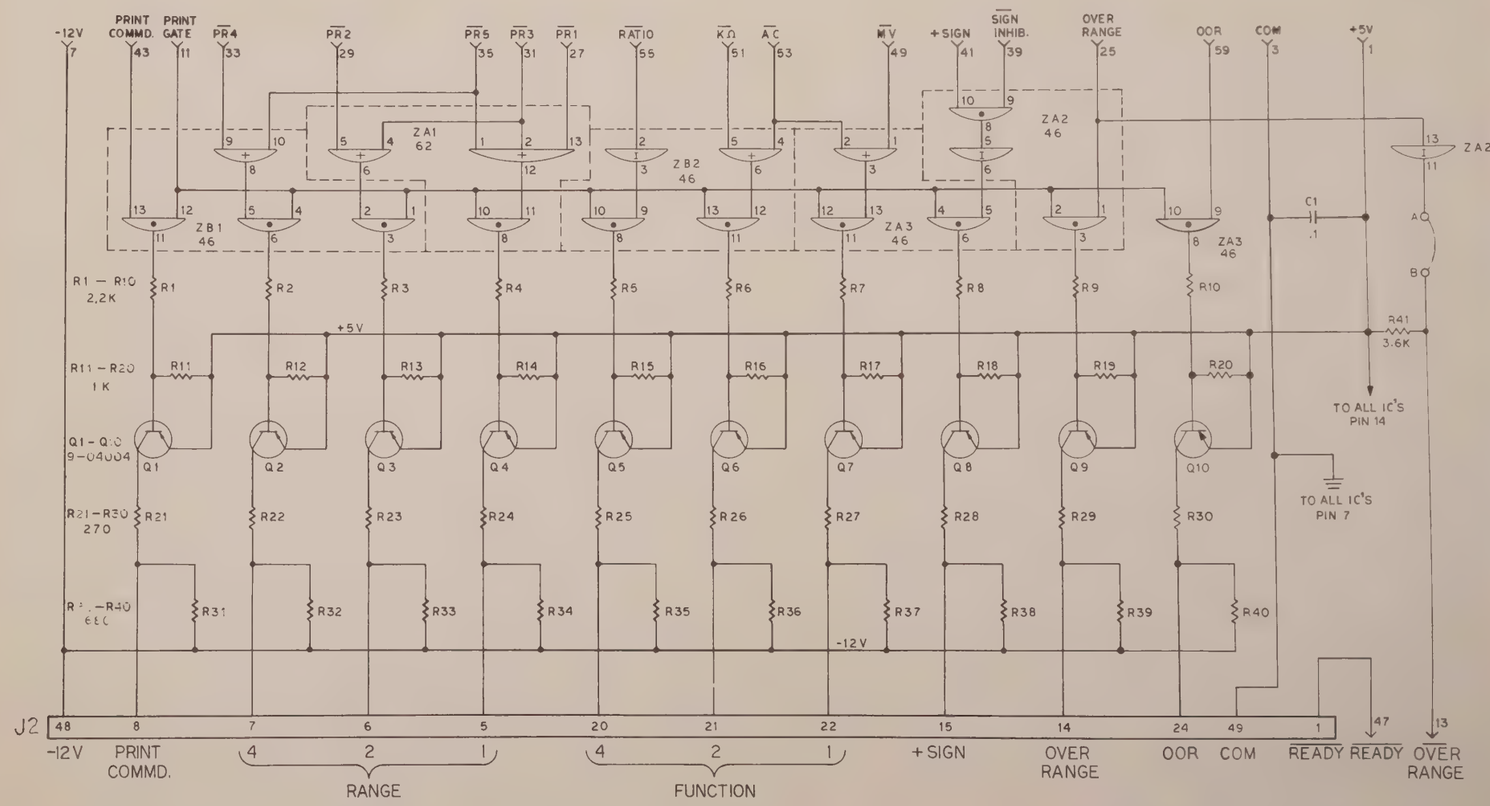
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A14)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7128-1		15318
2	1	CONNECTOR REC MIN 50 PIN	J2	67-0518-1		15318
3	22	CONTACT–ELECT		2-63904	5001-1923	91662
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	10	RES COMP 270	R21-R30	7-41236	RC07GF271J	MIL-R-11
6	10	RES COMP 680	R31-R40	7-41241	RC07GF681J	MIL-R-11
7	10	RES COMP 1K	R11-R20	7-41243	RC07GF102J	MIL-R-11
8	10	RES COMP 2.2K	R1-R10	7-41247	RC07GF222J	MIL-R-11
9	1	RES COMP 3.6K	R41	7-41300	RC07GF362J	MIL-R-11
10	4	IC QUAD 2 INPUT GATE	ZA2,ZA3,ZB1, ZB2	7-96008	MC846P	15873
11	1	IC TRIPLE 3 INPUT GATE	ZA1	7-96010	MC862P	15873
12	10	TRANSISTOR	Q1-Q10	9-04004	2N2907	JEDEC

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A14

Figure 6-19. BCD Voltage State No. 1 (–12) Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A14
4. ZA3, ZB2, C1, J2, Q10, R41, LAST NUMBER USED | J1 NUMBER NOT USED

Diagram 18. BCD Voltage State No. 1 (–12) Schematic.

BCD VOLTAGE STATE NO. 2 (–12)

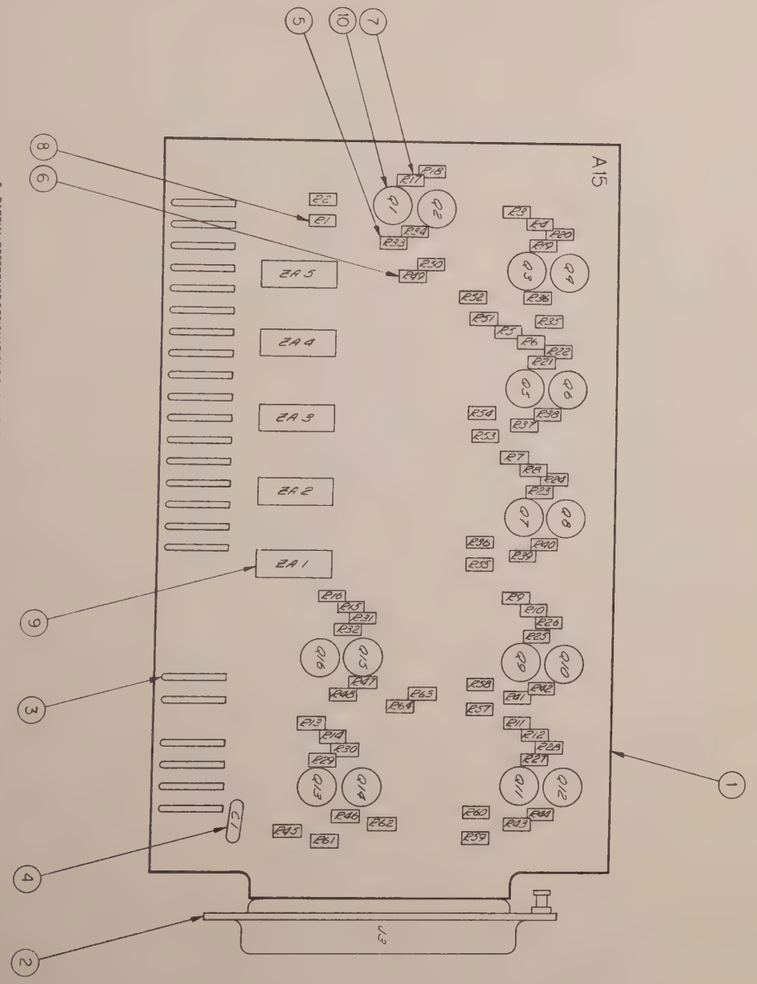
ASSEMBLY 66-6129

PARTS LIST

ASSEMBLY: BCD Voltage State No. 2 (−12) **SCHEMATIC NO.:** 66-0829 **PART NO.:** 66-6129

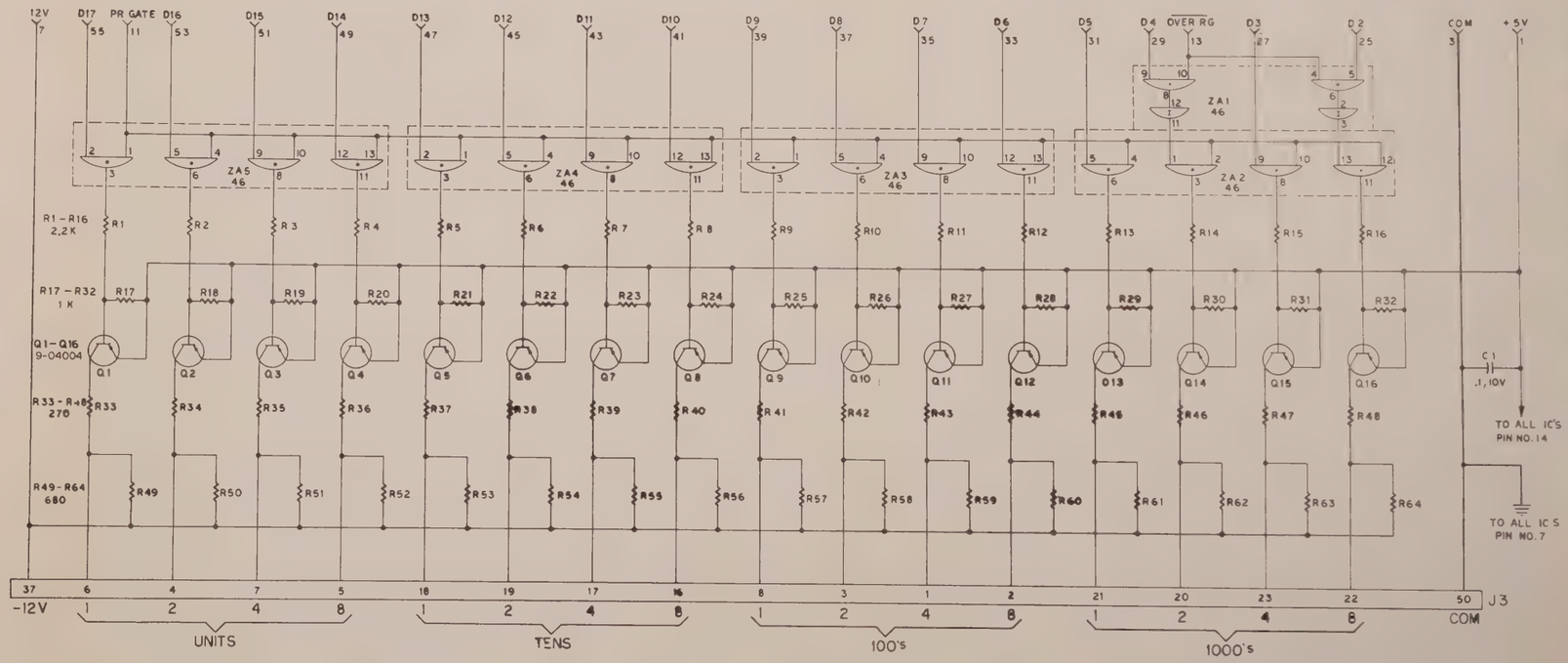
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A15)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD—ETCHED		66-7129-1		15318
2	1	CONNECTOR REC 50 PIN MIN	J3	67-0518-1		15318
3	23	CONTACT—ELEC		2-63904	5001-1923	91662
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	16	RES COMP 270	R33-R48	7-41236	RC07GF271J	MIL-R-11
6	16	RES COMP 680	R49-R64	7-41241	RC07GF681J	MIL-R-11
7	16	RES COMP 1K	R17-R32	7-41243	RC07GF102J	MIL-R-11
8	16	RES COMP 2.2K	R1-R16	7-41247	RC07GF222J	MIL-R-11
9	5	IC QUAD 2 INPUT GATE	ZA1-ZA5	7-96008	MC846P	15873
10	16	TRANSISTOR	Q1-Q16	9-04004	2N2907	JEDEC

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A15

Figure 6-20. BCD Voltage State No. 2 (–12) Assembly.



4. C1, J3, Q16, R64, ZA5 J1 , J2
LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A15
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

NOTES: UNLESS OTHERWISE SPECIFIED:

Diagram 19. BCD Voltage State No. 2 (–12) Schematic.

BCD VOLTAGE STATE NO. 1 (+12)

ASSEMBLY 66-6121

PARTS LIST

ASSEMBLY: BCD Voltage State No. 1 (+12) **SCHEMATIC NO.:** 66-0821 **PART NO.:** 66-6121

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A14)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7121-1		15318
2	1	CONNECTOR REC MIN 50 PIN	J2	67-0518-1		15318
3	1	CAP PAP 0.1 50V	C2	1-57321	VX5A104K	12406
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	1	RES COMP 330	R26	7-41237	RC07GF331J	MIL-R-11
6	1	RES COMP 560	R21	7-41240	RC07GF561J	MIL-R-11
7	10	RES COMP 12K	R11-R20	7-41256	RC07GF123J	MIL-R-11
8	1	RES COMP 3.6K	R22	7-41300	RC07GF362J	MIL-R-11
9	11	RES COMP 4.7K	R1-R10,R24	7-41251	RC07GF472J	MIL-R-11
10	1	RES TIN OXIDE 10K 1%	R25	7-46701	RN60D1002F	MIL-R-10509
11	1	RES TIN OXIDE 1.8K 1%	R23	7-46731	RN60D1801F	MIL-R-10509
12	23	DIODE	CR1-CR23	7-95647	1N914	JEDEC
13	2	IC QUAD 2 INPUT GATE	ZA2,ZA3	7-96008	MC846P	15873
14	1	IC TRIPLE 3 INPUT GATE	ZA1	7-96010	MC862P	15873
15	12	TRANSISTOR	Q1-Q12	9-04003	2N2222	JEDEC
16	25	CONTACT–ELECT		2-63904	5001-1923	91662

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A14

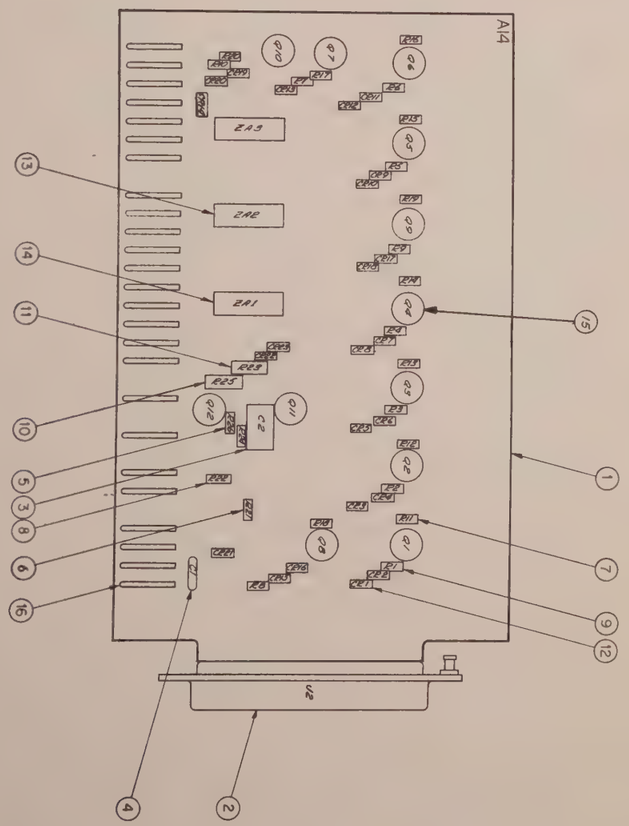
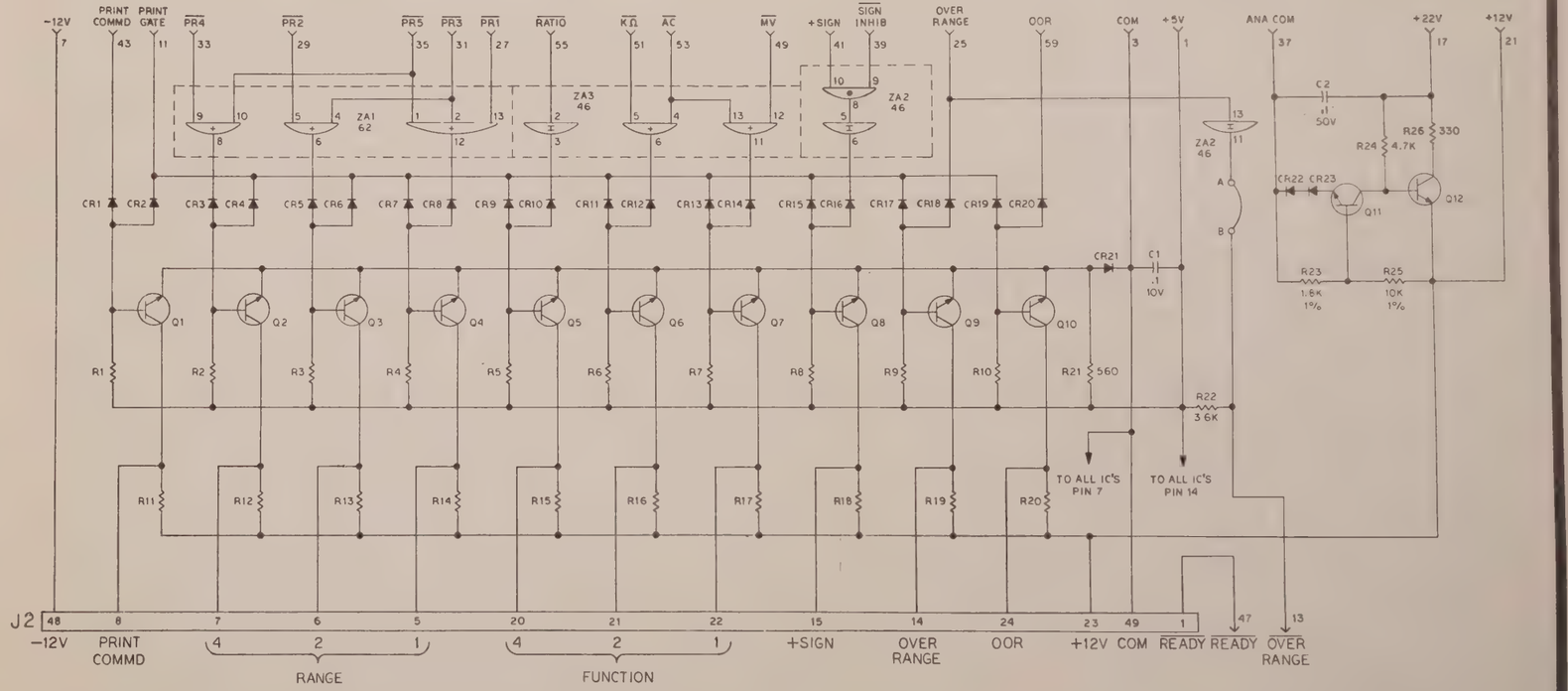


Figure 6-21. BCD Voltage State No. 1 (+12) Assembly.


-12V
PRINT COMMD
PRINT GATE
PR4
PR2
PR5
PR3
PR1
RATIO
KΩ
AC
MV
+SIGN
SIGN INHIB
OVER RANGE
OOR
COM
+5V
ANA COM
+22V
+12V
ZA1 62
ZA3 46
ZA2 46
CR1 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR20 CR21
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12
R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15 R16 R17 R18 R19 R20 R21 560 R22 3.6K R23 1.6K 1% R24 4.7K R25 10K 1% R26 330
C1 .1 10V
C2 1 50V
TO ALL IC'S PIN 7
TO ALL IC'S PIN 14
J2
-12V PRINT COMMD RANGE FUNCTION +SIGN OVER RANGE OOR +12V COM READY READY OVER RANGE

NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A14
4. R26, CR23, Q12, C2 | J1
   LAST NUMBER USED | NUMBER NOT USED
5. DIODES ARE 1N914
   J2, ZA3
6. TRANSISTORS ARE 9-04003
7. R1-R10 4.7K
8. R11-R20 12K

Diagram 20. BCD Voltage State No. 1 (+12) Schematic.

BCD VOLTAGE STATE NO. 2 (+12)

ASSEMBLY 66-6122

PARTS LIST

ASSEMBLY: BCD Voltage State No. 2 (+12) **SCHEMATIC NO.:** 66-0822 **PART NO.:** 66-6122

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A15)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7122-1		15318
2	1	CONNECTOR REC MIN 50 PIN	J3	67-0518-1		15318
3	22	CONTACT ELECT		2-63904	5001-1923	91662
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	1	RES COMP 560	R17	7-41240	RC07GF561J	MIL-R-11
6	16	RES COMP 4.7K	R1-R16	7-41251	RC07GF472J	MIL-R-11
7	16	RES COMP 12K	R18-R33	7-41256	RC07GF123J	MIL-R-11
8	33	DIODE	CR1-CR33	7-95647	1N914	JEDEC
9	1	IC QUAD 2 INPUT GATE	ZA1	7-96008	MC846P	15873
10	16	TRANSISTOR	Q1-Q16	9-04003	2N2222	JEDEC

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

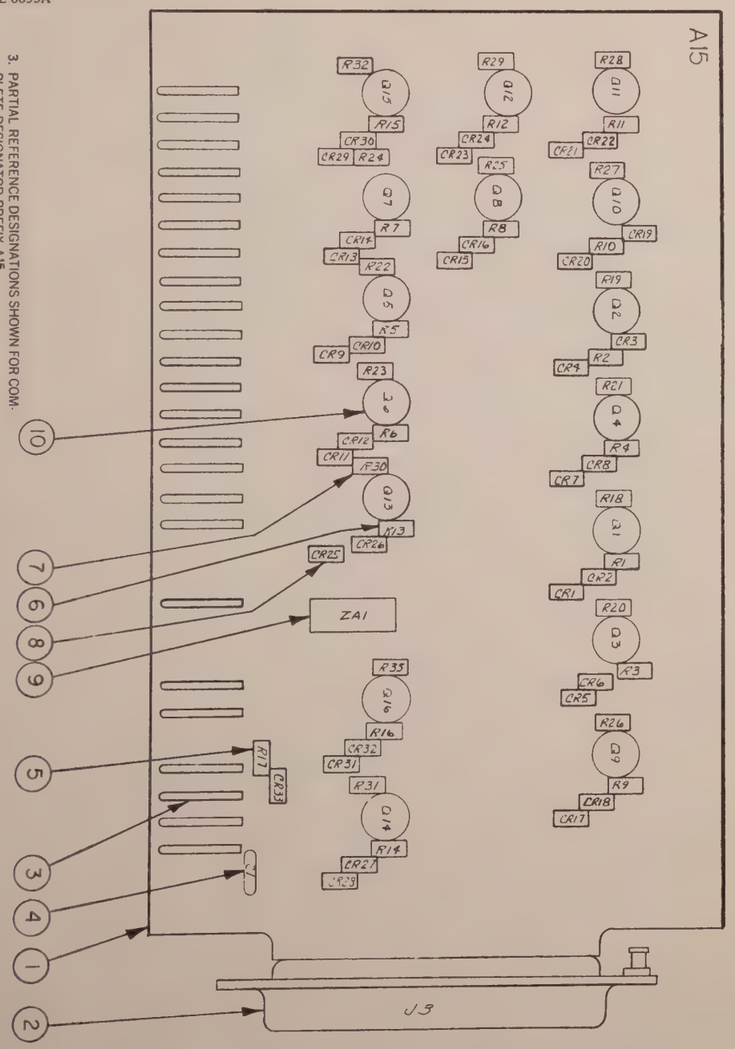
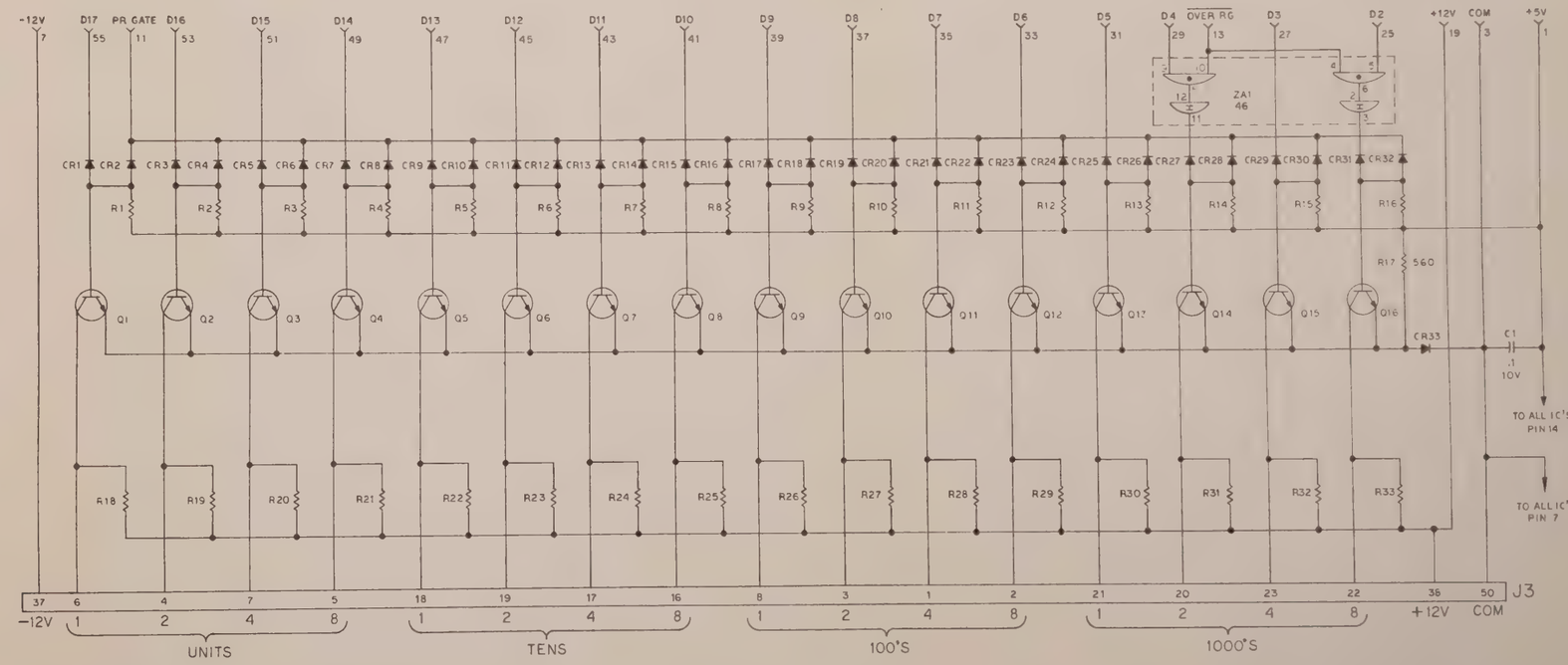


Figure 6-22. BCD Voltage State No. 2 (+12) Assembly.

NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COM-PLETE DESIGNATOR PREFIX A15



8. R18-R33 12K
7. Q1-Q16 9-04003
6. R1-R16 4.7K
5. DIODES ARE 1N914
   ZA1, C1, J3
4. R33, CR33, Q16 | J1, J2
   LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COM-PLETE DESIGNATOR PREFIX A15
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

NOTES: UNLESS OTHERWISE SPECIFIED:

Diagram 21. BCD Voltage State No. 2 (+12) Schematic.

BCD PRINT OUTPUT NO. 1

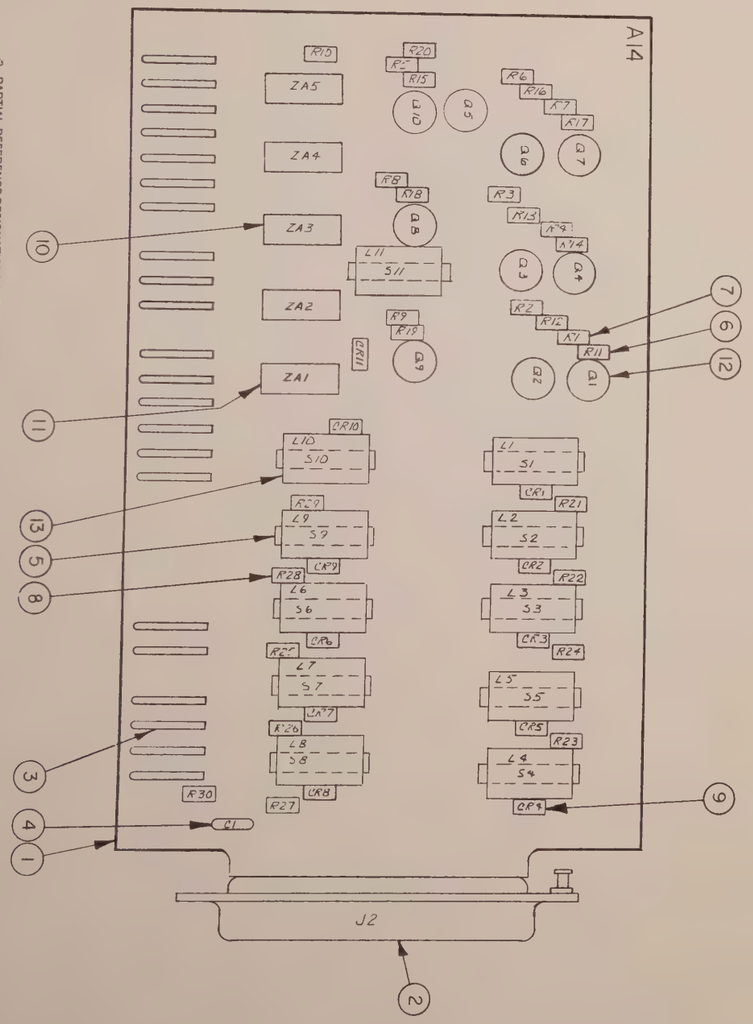
ASSEMBLY 66-6130

PARTS LIST

ASSEMBLY: BCD Print Output No. 1 **SCHEMATIC NO.:** 66-0830 **PART NO.:** 66-6130

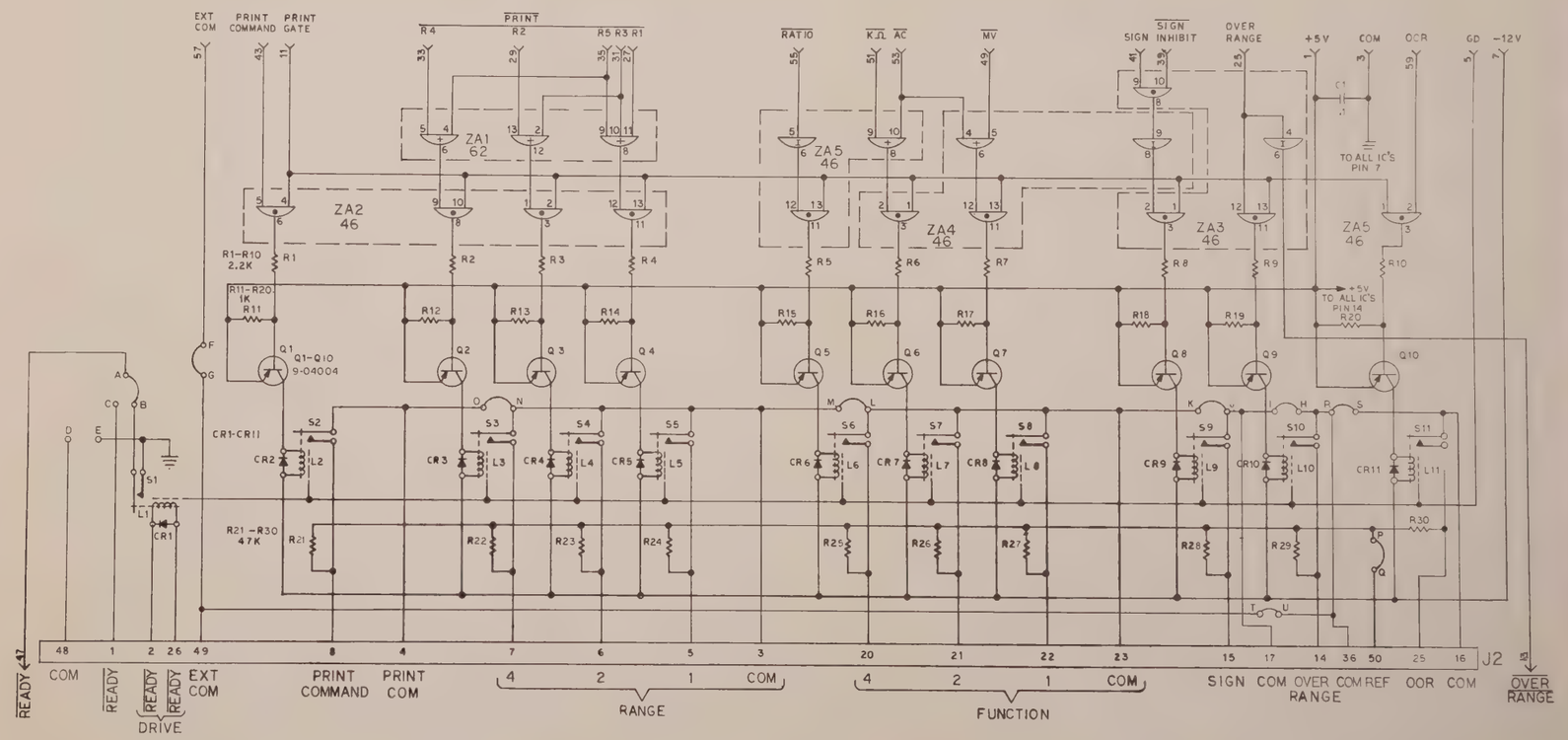
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A14)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7130-1		15318
2	1	CONNECTOR REC MIN 50 PIN	J2	67-0518-1		15318
3	22	CONTACT–ELECT		2-63904	5001-1923	91662
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	11	RELAY REED	S1-S11	7-38216	MR306-8	95348
6	10	RES COMP 1K	R11-R20	7-41243	RC07GF102J	MIL-R-11
7	10	RES COMP 2.2K	R1-R10	7-41247	RC07GF222J	MIL-R-11
8	10	RES COMP 47K	R21-R30	7-41263	RC07GF475J	MIL-R-11
9	11	SEMICOND DIODE	CR1-CR11	7-95647	1N914	JEDEC
10	4	IC QUAD 2 INPUT GATE	ZA2-ZA5	7-96008	MC846P	15873
11	1	IC TRIPLE 3 INPUT GATE	ZA1	7-96010	MC862P	15873
12	10	TRANSISTOR	Q1-Q10	9-04004	2N2907	JEDEC
13	11	COIL REED DRIVE	L1-L11	90-0504-1		15318

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A14

Figure 6-23. BCD Print Output No. 1 Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A14
4. R3C, ZA5, CR11, S11 / C1, J2, L11, Q10, | J1
   LAST NUMBER USED | NUMBER NOT USED

Diagram 22. BCD Print Output No. 1 Schematic.

BCD PRINT OUTPUT NO. 2

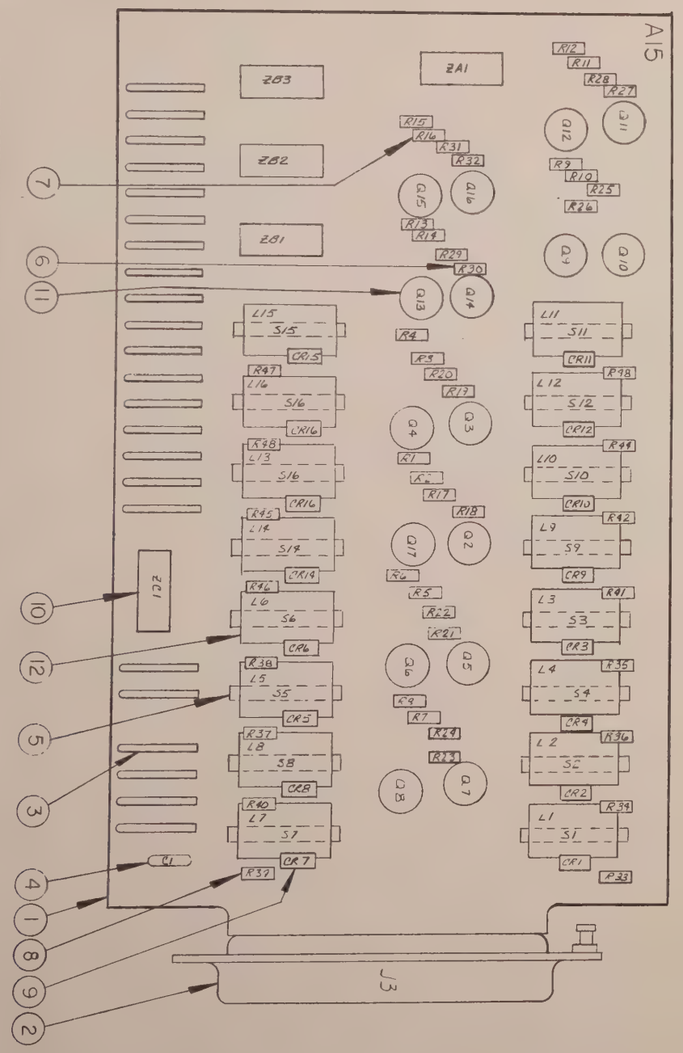
ASSEMBLY 66-6131

PARTS LIST

ASSEMBLY: BCD Print Output No. 2 **SCHEMATIC NO.:** 66-0831 **PART NO.:** 66-6131

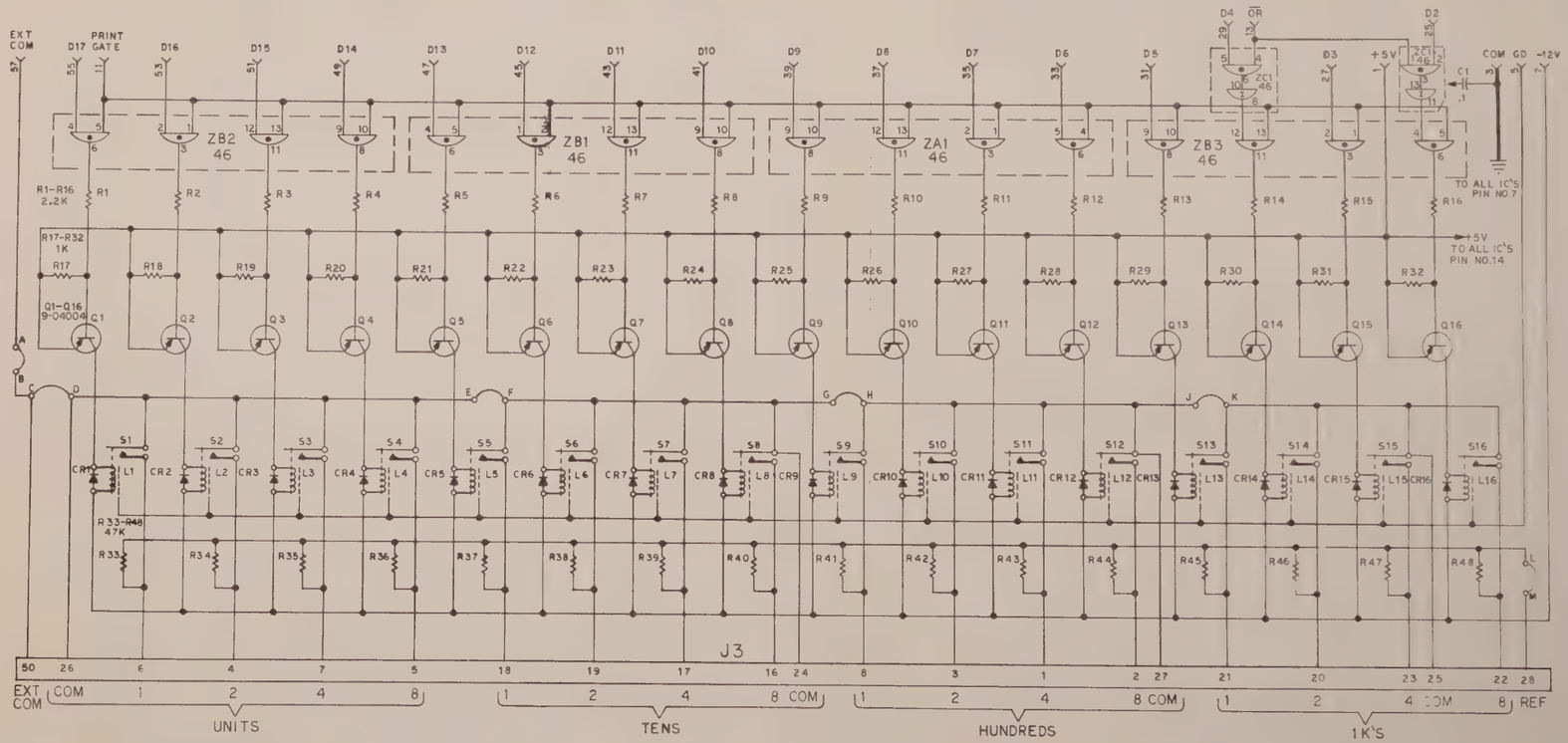
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A15)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7131-3		15318
2	1	CONNECTOR REC MIN 50 PIN	J3	67-0518-1		15318
3	23	CONTACT–ELECT		2-63904	5001-1923	91662
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	16	RELAY REED	S1-S16	7-38216	MR306-8	95348
6	16	RES COMP 1K	R17-R32	7-41243	RC07GF102J	MIL-R-11
7	16	RES COMP 2.2K	R1-R16	7-41247	RC07GF222J	MIL-R-11
8	16	RES COMP 47K	R33-R48	7-41263	RC07GF473J	MIL-R-11
9	16	SEMICOND DIODE	CR1-CR16	7-95647	1N914	JEDEC
10	5	IC QUAD 2 INPUT GATE	ZA1,ZB1-ZB3,ZC1	7-96008	MC846P	15873
11	16	TRANSISTOR	Q1-Q16	9-04004	2N2907	JEDEC
12	16	COIL REED DRIVE	L1-L16	90-0504-1		15318

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A15

Figure 6-24. BCD Print Output No. 2 Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A15
4. C1 L16 J3 Q16 | J1–J2
   LAST NUMBER USED | NUMBER NOT USED
5. ALL DIODES ARE 1N914
   R48 S16 ZA1 ZB3

Diagram 23. BCD Print Output No. 2 Schematic.

TEN-LINE PRINT OUTPUT NO. 1

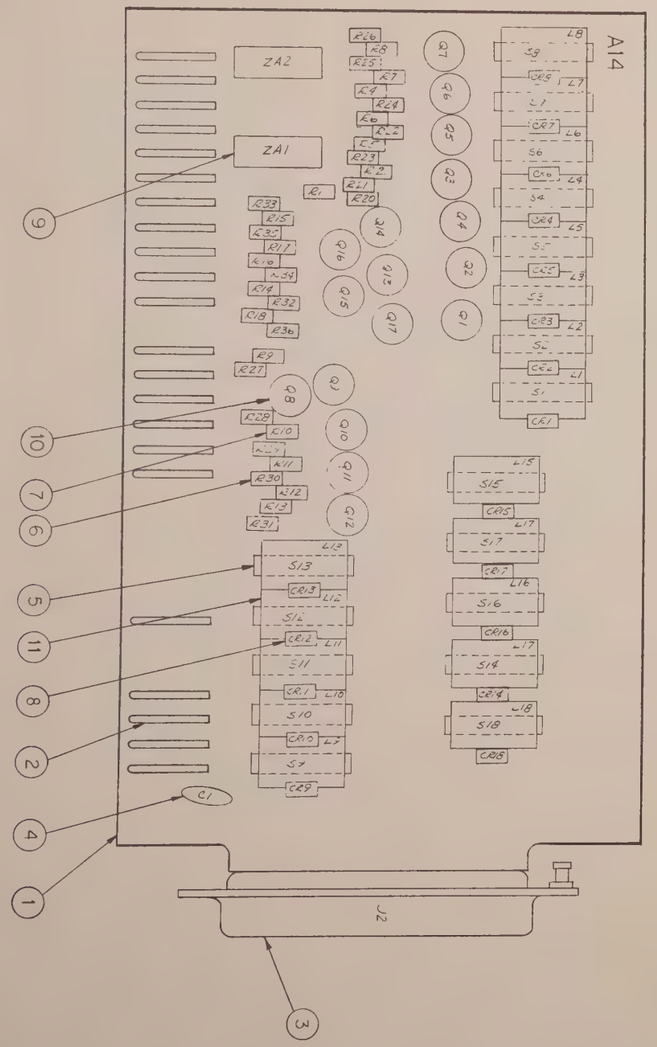
ASSEMBLY 66-6123

PARTS LIST

ASSEMBLY: 10 Line Print Output No. 1 **SCHEMATIC NO.:** 66-0823 **PART NO.:** 66-6123

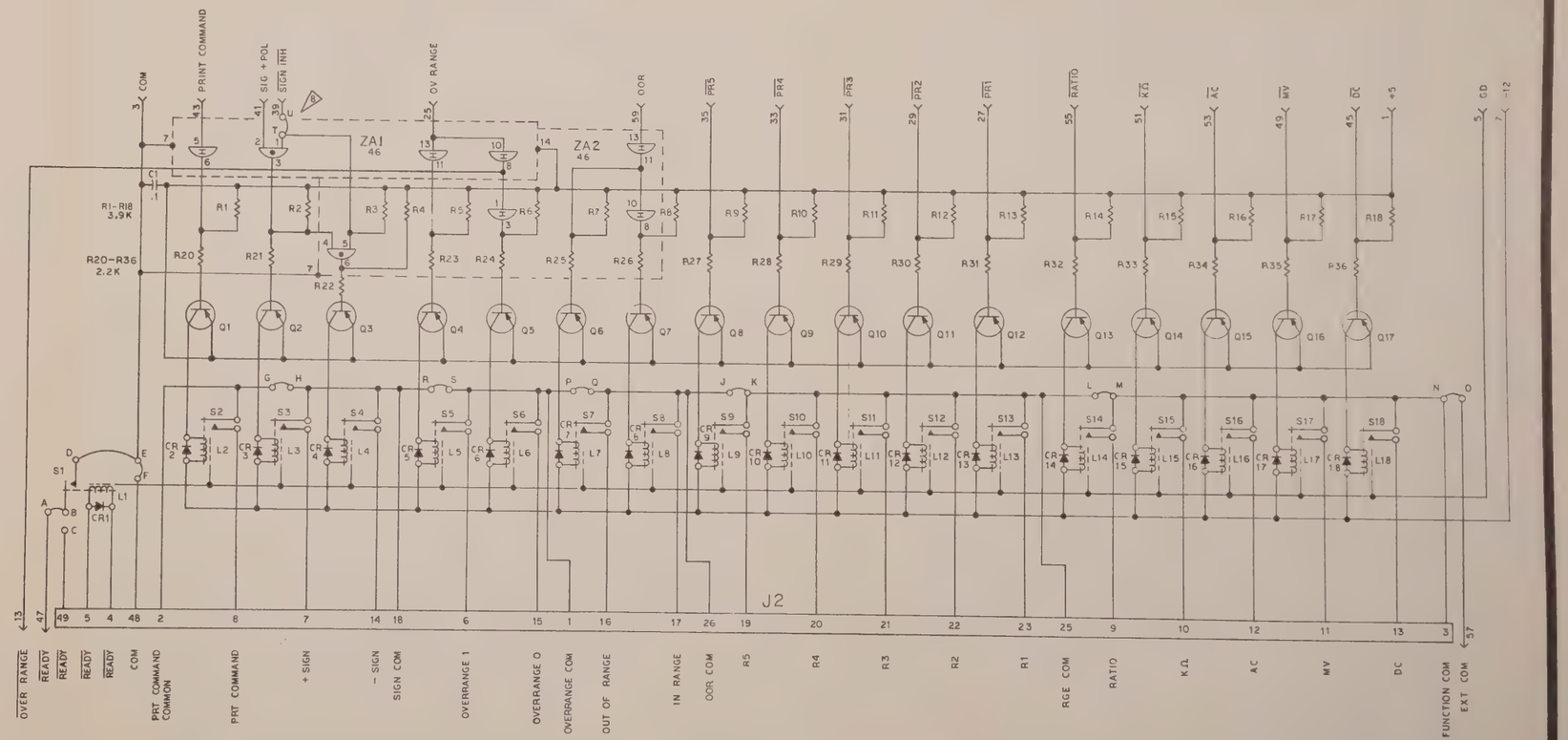
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A14)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7123-1		15318
2	22	CONTACT–ELECT		2-63904	5001-1923	91662
3	1	CONN REC MIN 50 PIN	J2	67-0518-1		15318
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	18	RELAY REED	S1-S18	7-38216	MR306-8	95348
6	17	RES COMP 2.2K	R20-R36	7-41247	RC07GF222J	MIL-R-11
7	17	RES COMP 3.9K	R1-R3,R5-R18	7-41250	RC07GF392J	MIL-R-11
8	18	SEMICOND DIODE	CR1-CR18	7-95647	1N914	JEDEC
9	2	IC QUAD 2 INPUT GATE	ZA1,ZA2	7-96008	MC846P	15873
10	17	TRANSISTOR	Q1-Q17	9-04004	2N2907	JEDEC
11	18	COIL REED DRIVE	L1-L18	90-0504-1		15318
12	1	RES COMP 3.3K	R4	7-41249	RC07GF332J	MIL-R-11

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A14

Figure 6-25. Ten-Line Print Output No. 1 Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX
4. R36, Q17, S18, L18 | J1, R19
   LAST NUMBER USED | NUMBER NOT USED
5. DIODES ARE 1N914
   CR18, J2, ZA2
6. TRANSISTORS ARE 9-04004
7. ALL JUMPERS INSTALLED AS SHOWN AT FACTORY
8. REMOVE JUMPER TO ENABLE SIGN FOR AC AND OHMS

Diagram 24. Ten-Line Print Output No. 1 Schematic.

TEN-LINE PRINT OUTPUT NO. 2

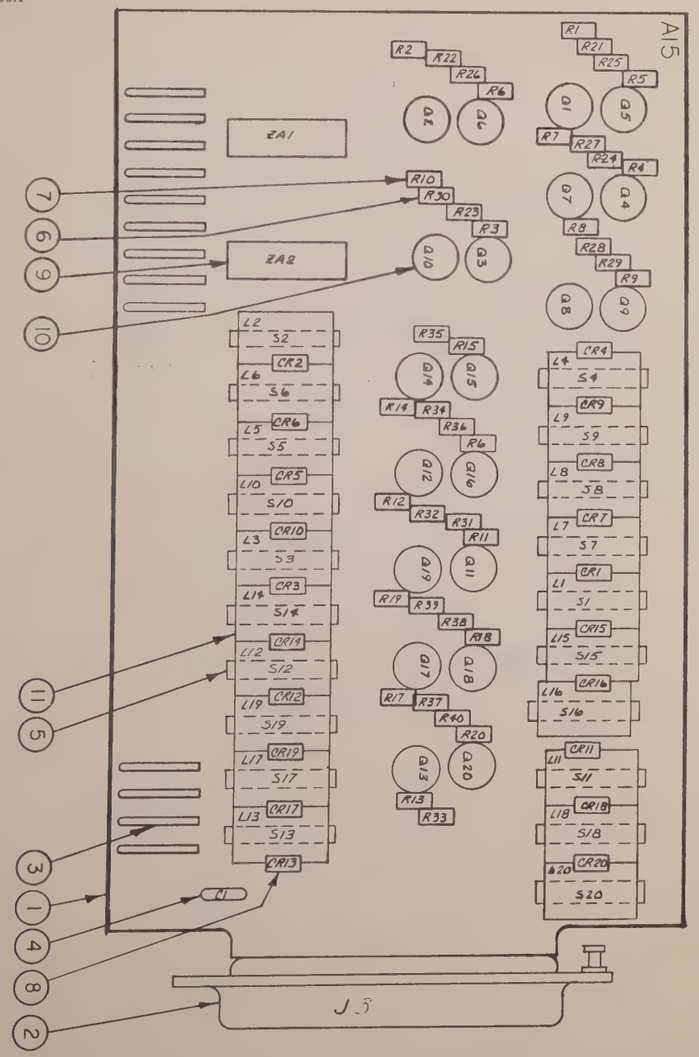
ASSEMBLY 66-6124

PARTS LIST

ASSEMBLY: 10-Line Print Output No. 2 **SCHEMATIC NO.:** 66-0824 **PART NO.:** 66-6124

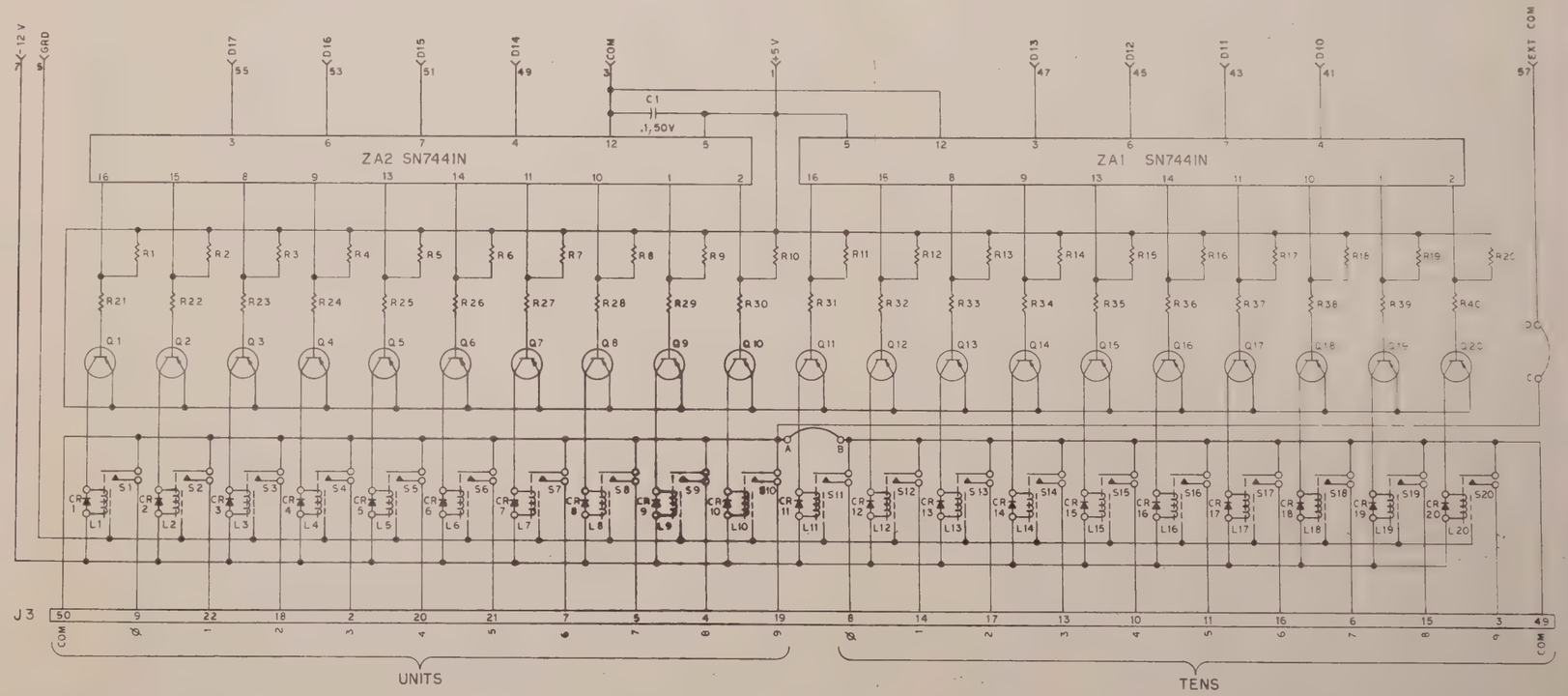
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A15)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7124-1		15318
2	1	CONNECTOR REC MIN 50 PIN	J3	67-0518-1		15318
3	13	CONTACT ELECT		2-63904	5001-1923	91662
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	20	RELAY REED	S1-S20	7-38216	MR306-8	95348
6	20	RES COMP 2.2K	R21-R40	7-41247	RC07GF222J	MIL-R-11
7	20	RES COMP 3.9K	R1-R20	7-41250	RC07GF392J	MIL-R-11
8	20	SEMICOND DIODE	CR1-CR20	7-95647	1N914	JEDEC
9	2	INTEGRATED CIRCUIT	ZA1,ZA2	7-96032	TDD1100E	01295
10	20	TRANSISTOR	Q1-Q20	9-04004	2N2907	JEDEC
11	20	COIL REED DRIVE	L1-L20	90-0504-1		15318

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A15

Figure 6-26. Ten-Line Print Output No. 2 Assembly.



8. TRANSISTORS ARE 9-04004
7. R21 THRU R40 ARE 2.2K
6. R1 THRU R20 ARE 3.9K
5. ALL DIODES ARE 1N914

4. C1, CR20, L20, Q20, J1 & J2 | R40, S20, ZA2, J3
LAST NUMBER USED | NUMBER NOT USED

3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A15
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

NOTES: UNLESS OTHERWISE SPECIFIED

Diagram 25. Ten-Line Print Output No. 2 Schematic.

TEN-LINE PRINT OUTPUT NO. 3

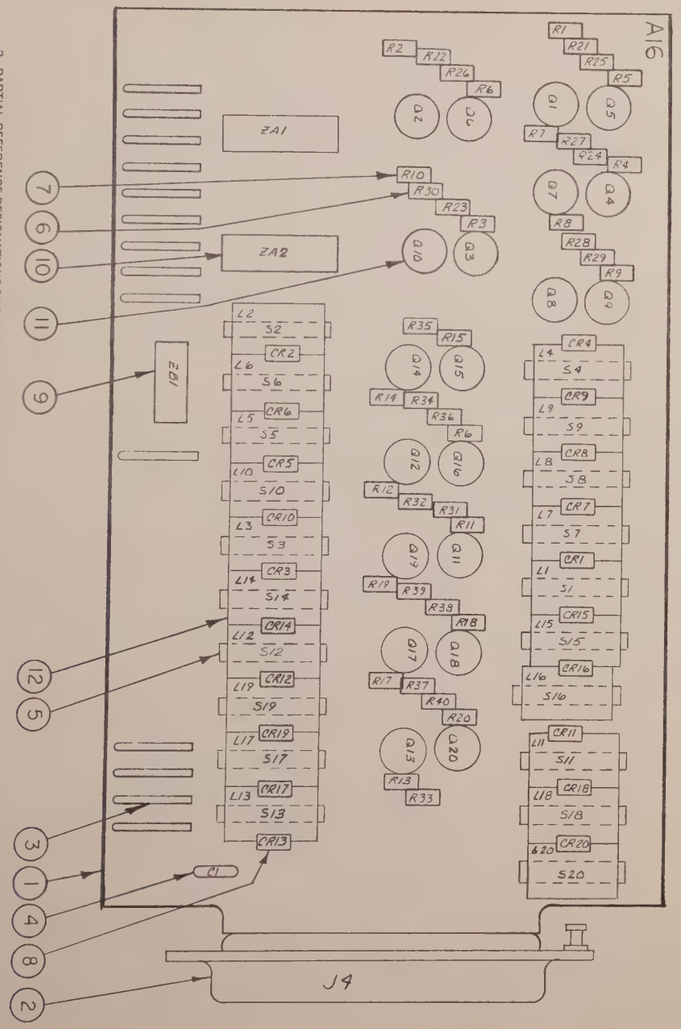
ASSEMBLY 66-6125

PARTS LIST

ASSEMBLY: 10-Line Print Output No. 3 **SCHEMATIC NO.:** 66-0825 **PART NO.:** 66-6125

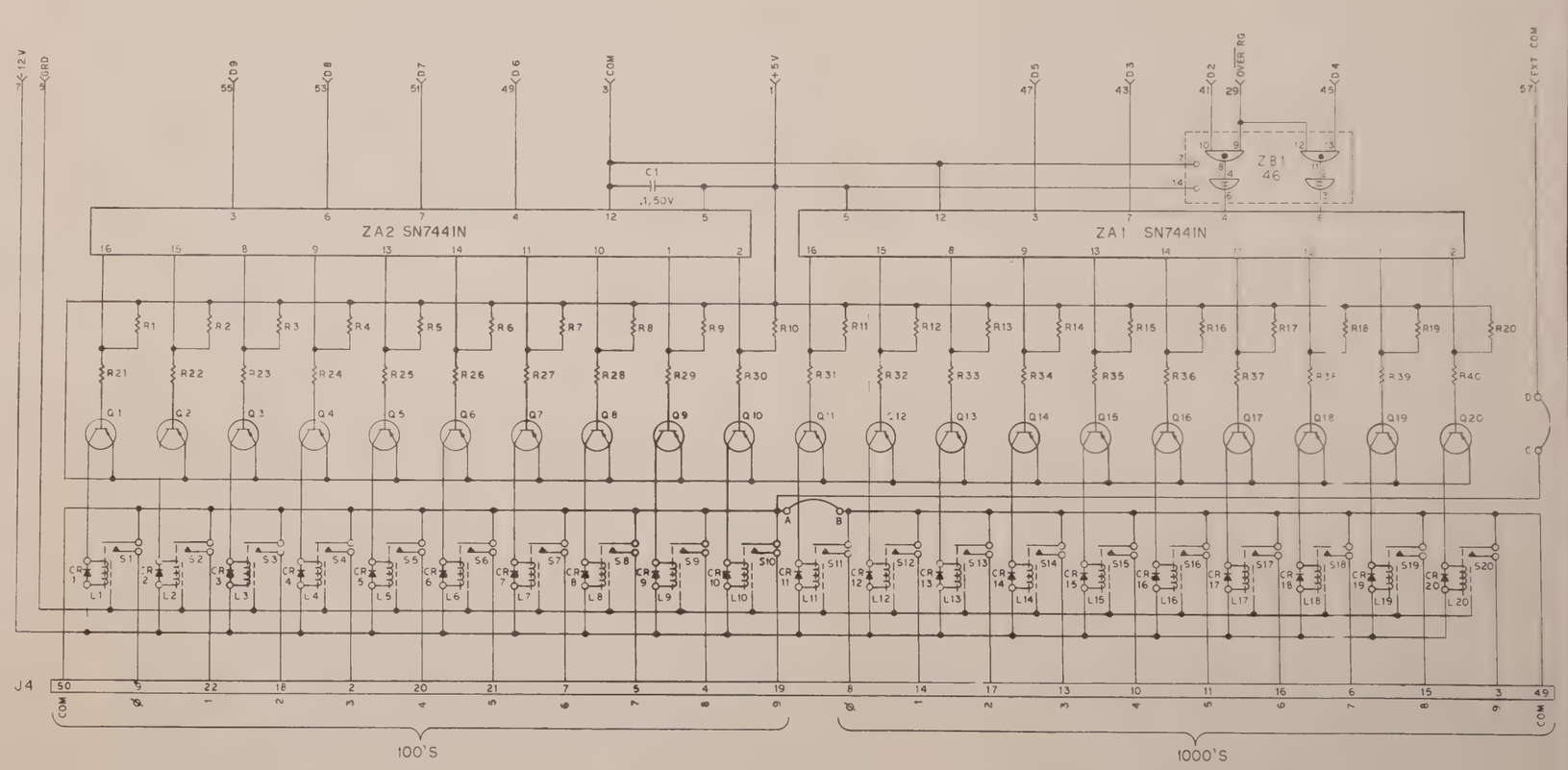
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A16)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7125-1		15318
2	1	CONNECTOR REC MIN 50 PIN	J4	67-0518-1		15318
3	14	CONTACT–ELECT		2-63904	5001-1923	91662
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	20	RELAY REED	S1-S20	7-38216	MR306-8	95348
6	20	RES COMP 2.2K	R21-R40	7-41247	RC07GF222J	MIL-R-11
7	20	RES COMP 3.9K	R1-R20	7-41250	RC07GF392J	MIL-R-11
8	20	SEMICOND DIODE	CR1-CR20	7-95647	1N914	JEDEC
9	1	IC QUAD 2 INPUT GATE	ZB1	7-96008	MC846P	15873
10	2	INTEGRATED CIRCUIT	ZA1,ZA2	7-96032	SN7441AN	01295
11	20	TRANSISTOR	Q1-Q20	9-04004	2N2907	JEDEC
12	20	COIL REED DRIVE	L1-L20	90-0504-1		15318

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A16

Figure 6-27. Ten-Line Print Output No. 3 Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A16
4. C1, CR20, L20, Q20 | J1 THRU J3
   LAST NUMBER USED | NUMBER NOT USED
5. ALL DIODES ARE 1N914
6. R1 THRU R20 ARE 3.9K
7. R21 THRU R40 ARE 2.2K
8. TRANSISTORS ARE 9-04004

Diagram 26. Ten-Line Print Output No. 3 Schematic.

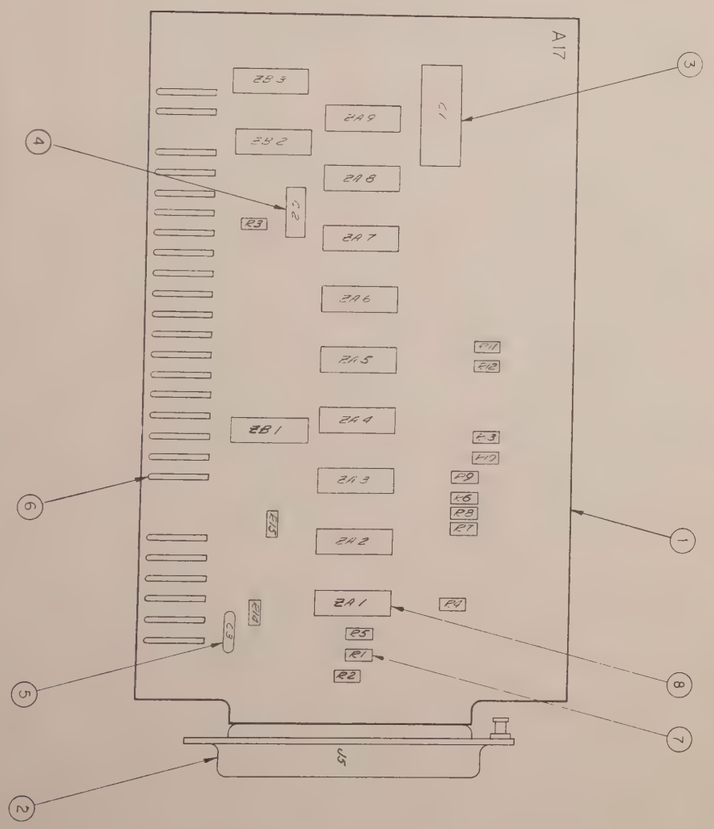
REMOTE NO. 1

ASSEMBLY 66-6134

PARTS LIST

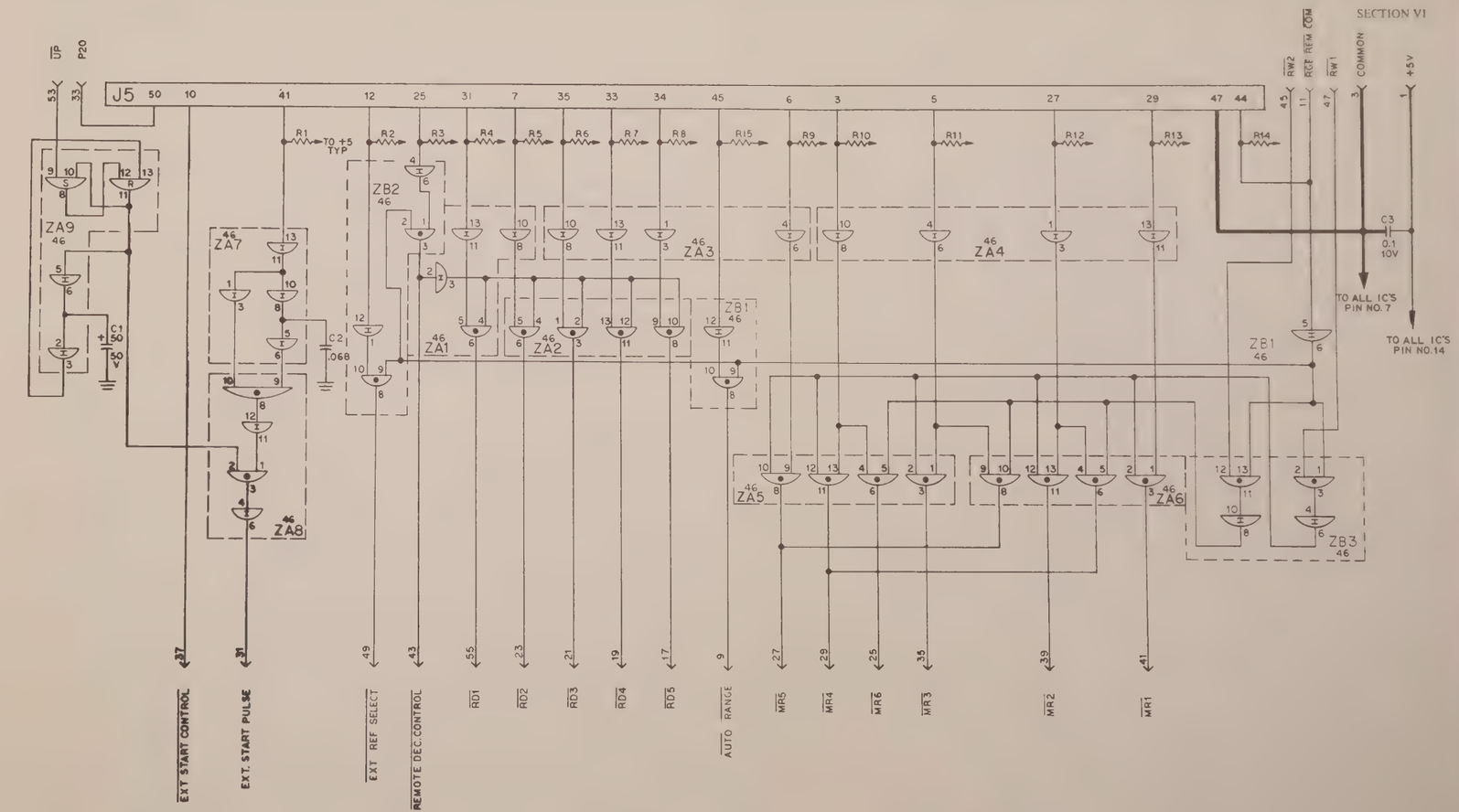
ASSEMBLY: Remote No. 1			SCHEMATIC NO.: 66-0834		PART NO.: 66-6134	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A17)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7134-1		15318
2	1	CONNECTOR 50 PIN MIN	J5	67-0518-1		15318
3	1	CAP ELECT 50 50V	C1	1-57257	TE-1307	56289
4	1	CAP PAP 0.068 50V	C2	1-57322	VX5A683K	12406
5	1	CAP CER DISC 0.1 10V	C3	1-57525	HY320	56289
6	25	CONTACT–ELECT		2-63904	5001-1923	91662
7	15	RES COMP 3.6K	R1-R15	7-41300	RC07GF362J	MIL-R-11
8	12	IC QUAD 2 INPUT GATE	ZA1-ZA9, ZB1-ZB3	7-96008	MC846P	15873

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COM-PLETE DESIGNATOR PREFIX A17

Figure 6-28. Remote No. 1 Assembly.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COM-PLETE DESIGNATOR PREFIX A17
4. C3,R15,J5,ZA9, ZB3 | J1 THRU J4
   LAST NUMBER USED | NUMBER NOT USED
5. R1 THRU R15 3.6K

Diagram 27. Remote No. 1 Schematic.

REMOTE NO. 2

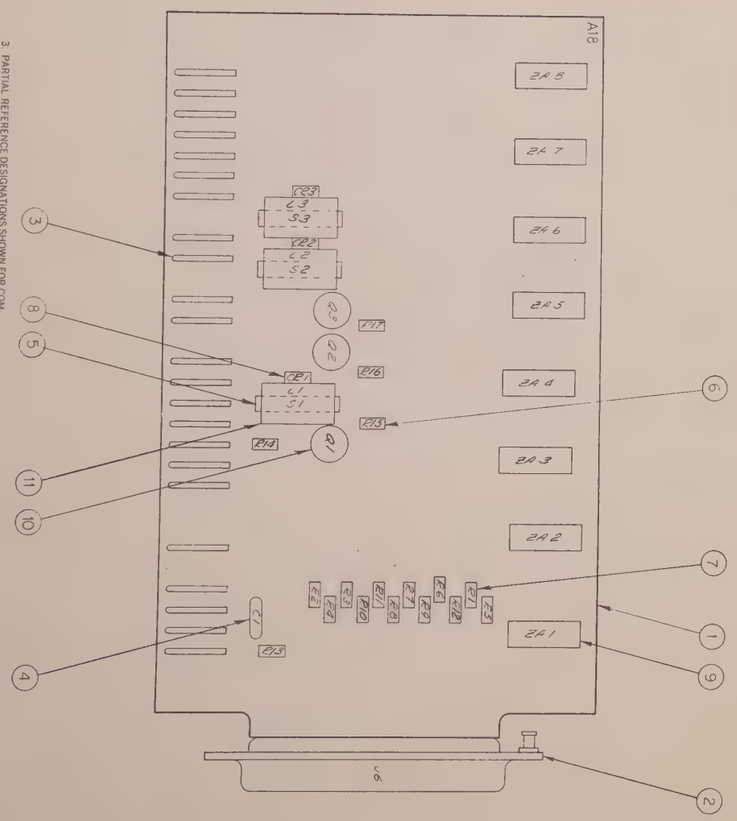
ASSEMBLY 66-6135

PARTS LIST

ASSEMBLY: Remote No. 2 **SCHEMATIC NO.:** 66-0835 **PART NO.:** 66-6135

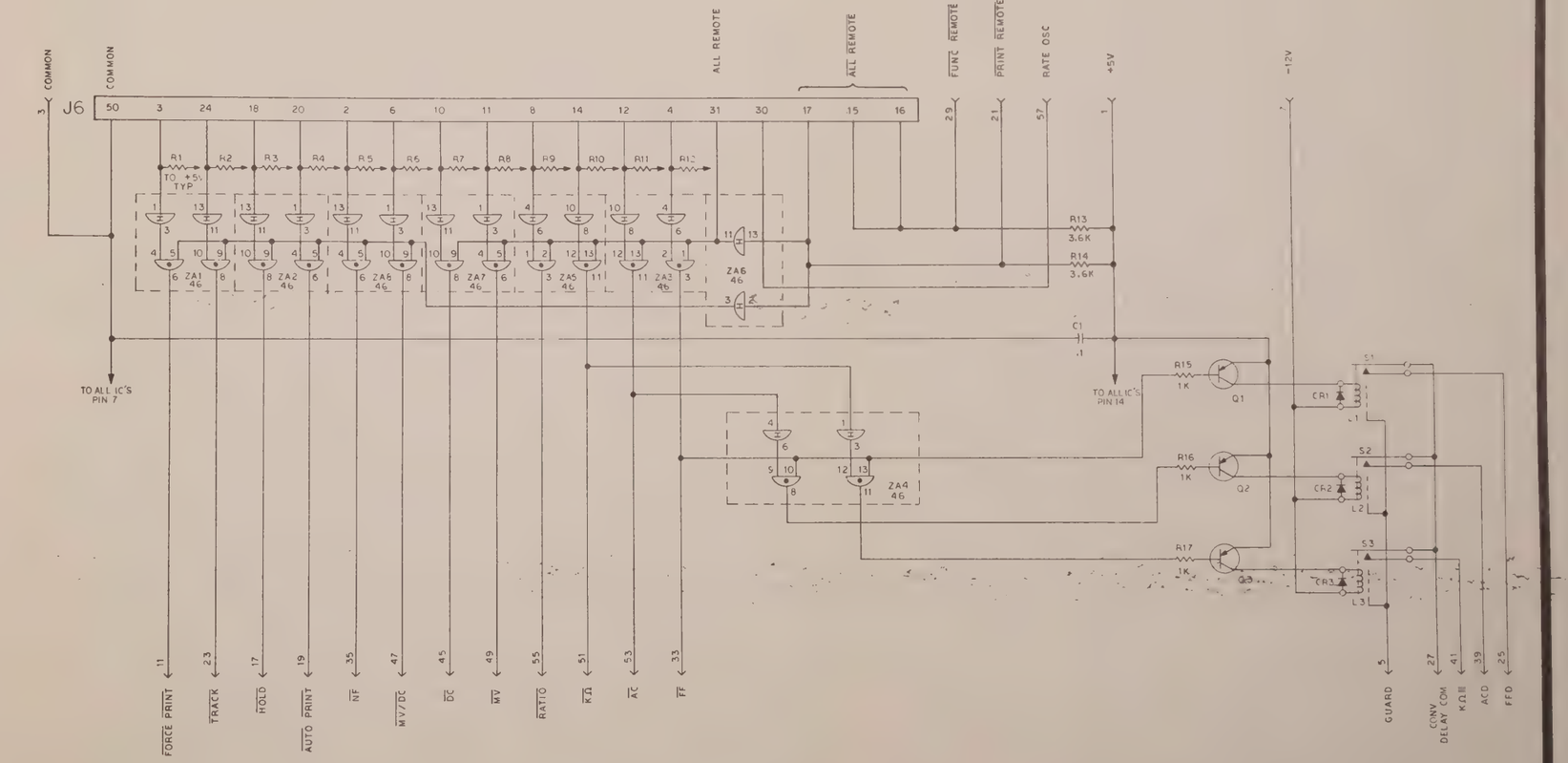
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A18)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7135-1		15318
2	1	CONNECTOR 50 PIN MIN	J6	67-0518-1		15318
3	23	CONTACT–ELECT		2-63904	5001-1923	91662
4	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
5	3	REED RELAY	S1-S3	7-38216	MR306-8	95348
6	3	RES COMP 1K	R15-R17	7-41243	RC07GF102J	MIL-R-11
7	14	RES COMP 3.6K	R1-R14	7-41300	RC07GF362J	MIL-R-11
8	3	SEMICOND DIODE	CR1-CR3	7-95647	1N914	JEDEC
9	8	IC QUAD 2 INPUT GATE	ZA1-ZA8	7-96008	MC846P	15873
10	3	TRANSISTOR	Q1-Q3	9-04004	2N2907	JEDEC
11	3	COIL REED DRIVE	L1-L3	90-0504-1		15318

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES:
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COM-PLETE DESIGNATOR PREFIX A18
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W UNLESS OTHERWISE SPECIFIED

Figure 6-29. Remote No. 2 Assembly.



L3, Q3, J6, ZA8
4 R17, CR3, C1, S3 | J1-J5
LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COM-PLETE DESIGNATOR PREFIX A18
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
NOTES: UNLESS OTHERWISE SPECIFIED

7. CR1-CR3 1N914
6. Q1-Q3 9-04004
5. R1-R12 3.6K

Diagram 28. Remote No. 2 Schematic.

REMOTE BUFFER NO. 1

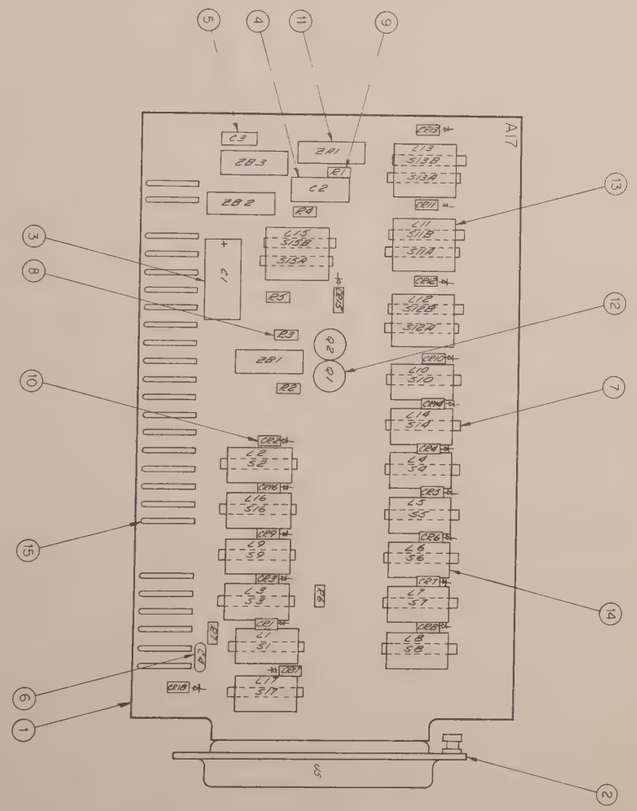
ASSEMBLY 66-6132

PARTS LIST

ASSEMBLY: Remote Buffer No. 1 **SCHEMATIC NO.:** 66-0832 **PART NO.:** 66-6132

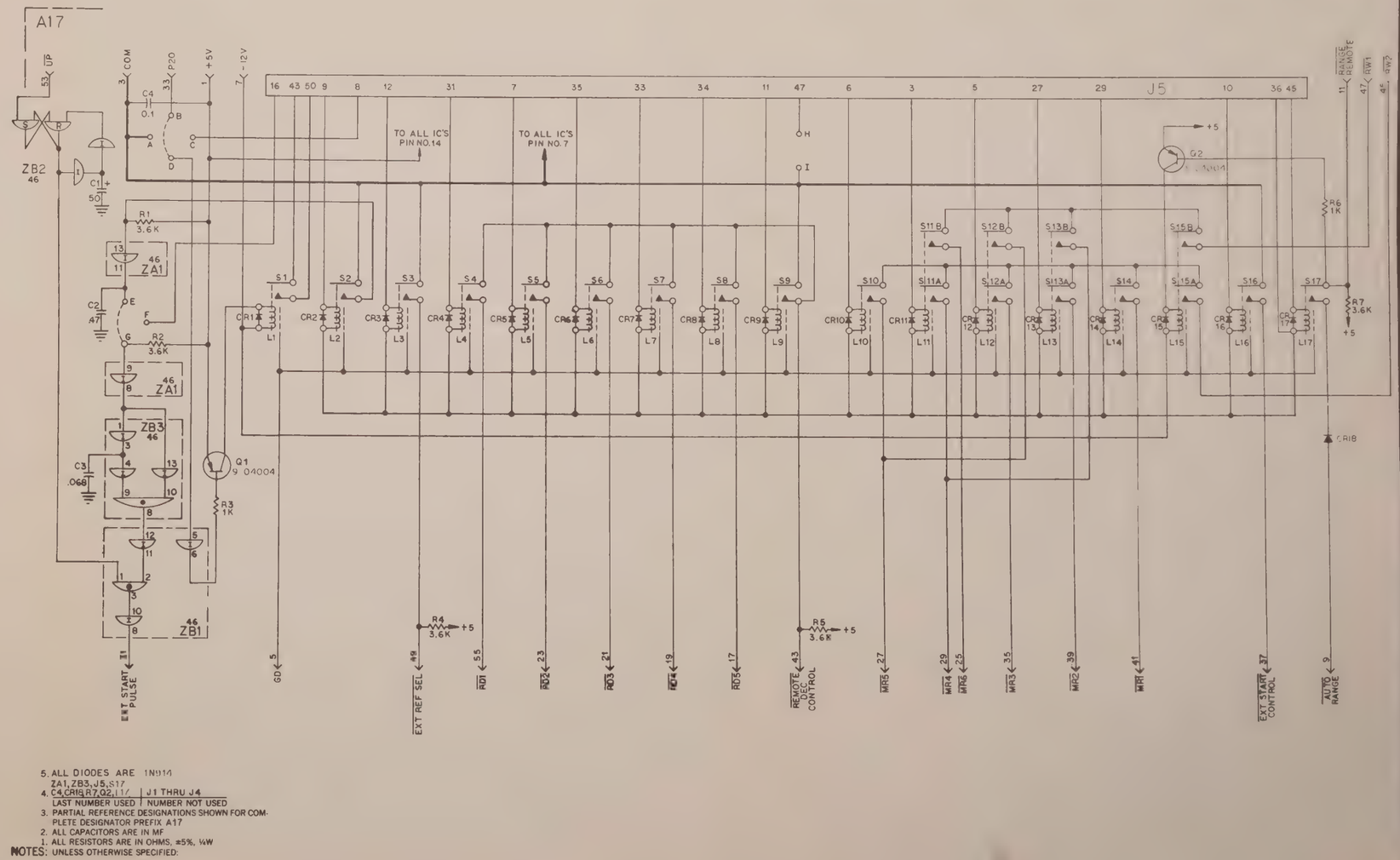
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A17)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7132-1		15318
2	1	CONNECTOR REC MIN 50 PIN	J5	67-0518-1		15318
3	1	CAP ELECT 50 25V	C1	1-57228	NLW 50-25	14655
4	1	CAP MET PAP 0.47 50V	C2	1-57318	VX5A474K	12406
5	1	CAP MET PAP 0.068 50V	C3	1-57322	VX5A683K	12406
6	1	CAP CER DISC 0.1 10V	C4	1-57525	HY320	56289
7	17	RELAY REED	S1-S17	7-38216	MR306-8	95348
8	2	RES COMP 1K	R3,R6	7-41243	RC07GF102J	MIL-R-11
9	5	RES COMP 3.6K	R1,R2,R4,R5,R7	7-41300	RC07GF362J	MIL-R-11
10	17	SEMICOND DIODE	CR1-CR17	7-95647	1N914	JEDEC
11	4	IC QUAD 2 INPUT GATE	ZA1,ZB1-ZB3	7-96008	MC846P	15873
12	2	TRANSISTOR	Q1,Q2	9-04004	2N2907	JEDEC
13	4	COIL REED DRIVE	L11-L13,L15	80-0501-1		15318
14	13	COIL REED DRIVE	L1-L10,L14, L16-L17	90-0504-1		15318
15	25	CONTACT – ELECT		2-63904	5001-1923	91662

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A17

Figure 6-30. Remote Buffer No. 1 Assembly.



5. ALL DIODES ARE 1N914
4. C4,CR16,R7,Q2,L17 | J1 THRU J4
   LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A17
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

NOTES: UNLESS OTHERWISE SPECIFIED:

Diagram 29. Remote Buffer No. 1 Schematic.

REMOTE BUFFER NO. 2

ASSEMBLY 66-6133

PARTS LIST

ASSEMBLY: Remote Buffer No. 2 **SCHEMATIC NO.:** 66-0833 **PART NO.:** 66-6133

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A18)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7133-1		15318
2	1	CONNECTOR REC MIN 50 PIN	J6	67-0518-1		15318
3	23	CONTACT–ELECT		2-63904	5001-1923	91662
4	17	RELAY REED	S1-S17	7-38216	MR306-8	95348
5	1	RES COMP 47K	R6	7-41263	RC07GF473J	MIL-R-11
6	5	RES COMP 1K	R2-R5,R7	7-41243	RC07GF102J	MIL-R-11
7	2	RES COMP 3.6K	R1, R8	7-41300	RC07GF362J	MIL-R-11
8	17	SEMICOND DIODE	CR1-CR17	7-95647	1N914	JEDEC
9	2	IC QUAD 2 INPUT GATE	ZA1, ZB1	7-96008	MC846P	15873
10	5	TRANSISTOR	Q1-Q5	9-04004	2N2907	JEDEC
11	17	COIL REED DRIVE	L1-L17	90-0504-1		15318

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

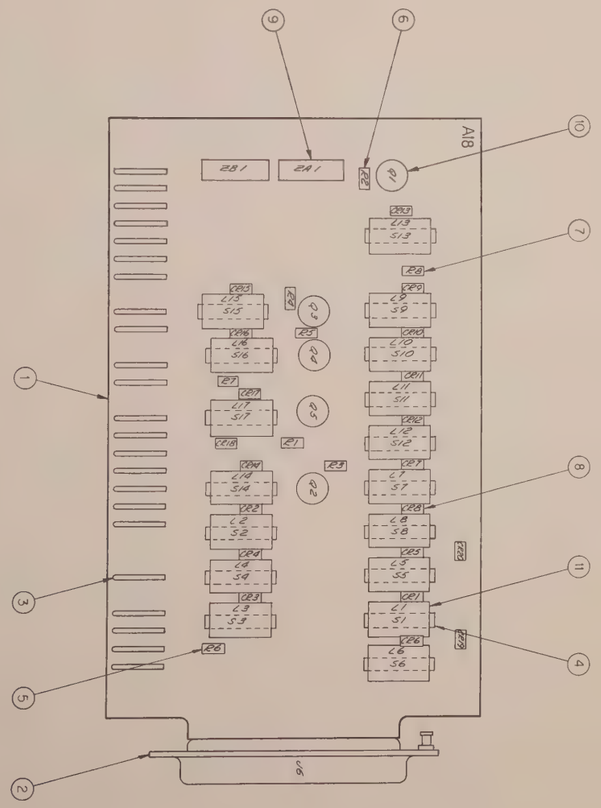
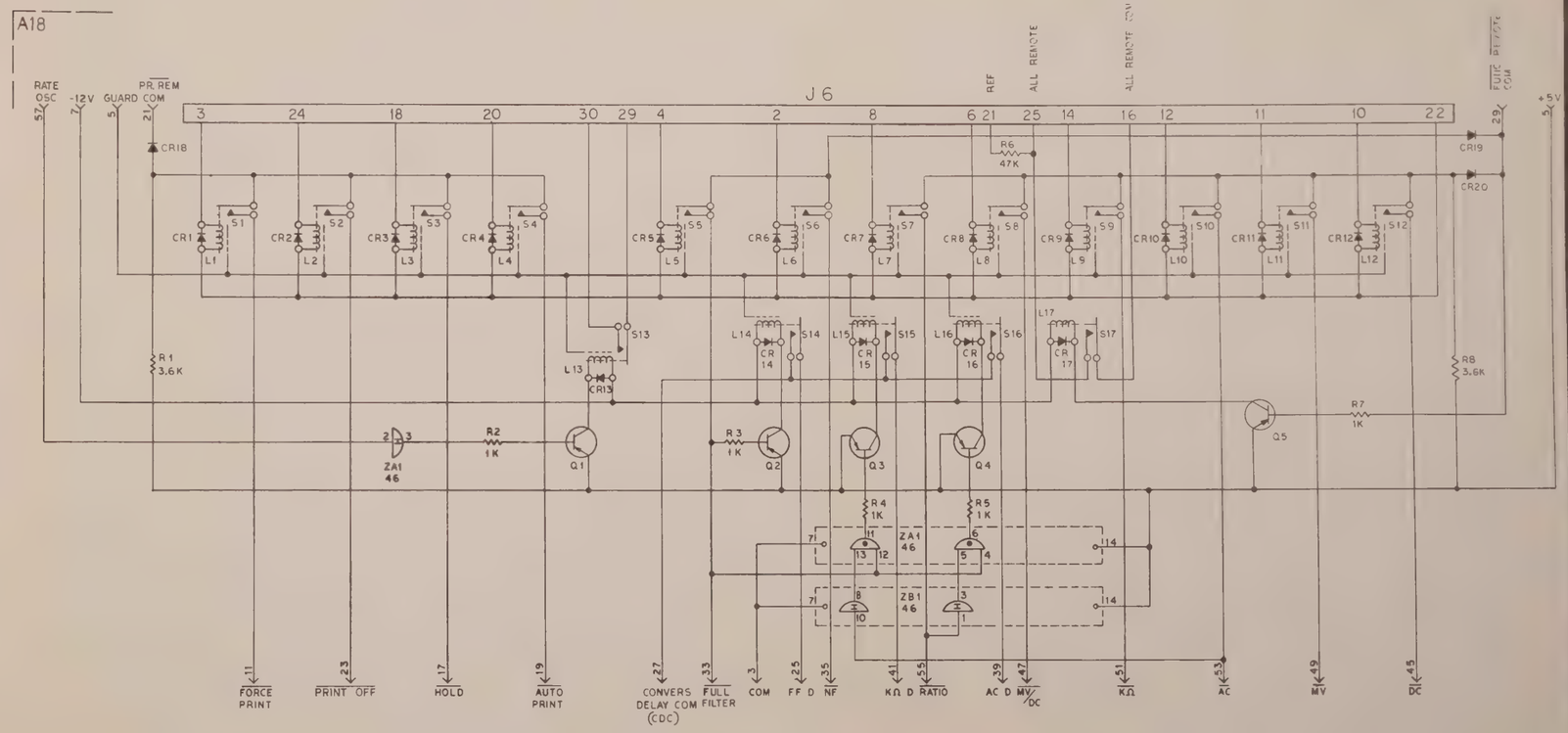


Figure 6-31. Remote Buffer No. 2 Assembly.

NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A18



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A18
4. CR20, J6, Q5, R8 | J1 - J5
   LAST NUMBER USED | NUMBER NOT USED
5. ALL DIODES ARE 1N914
   ZA1, ZB1, L17, S17
6. ALL TRANSISTORS ARE 9-04004

Diagram 30. Remote Buffer No. 2 Schematic.

SAMPLE AND HOLD

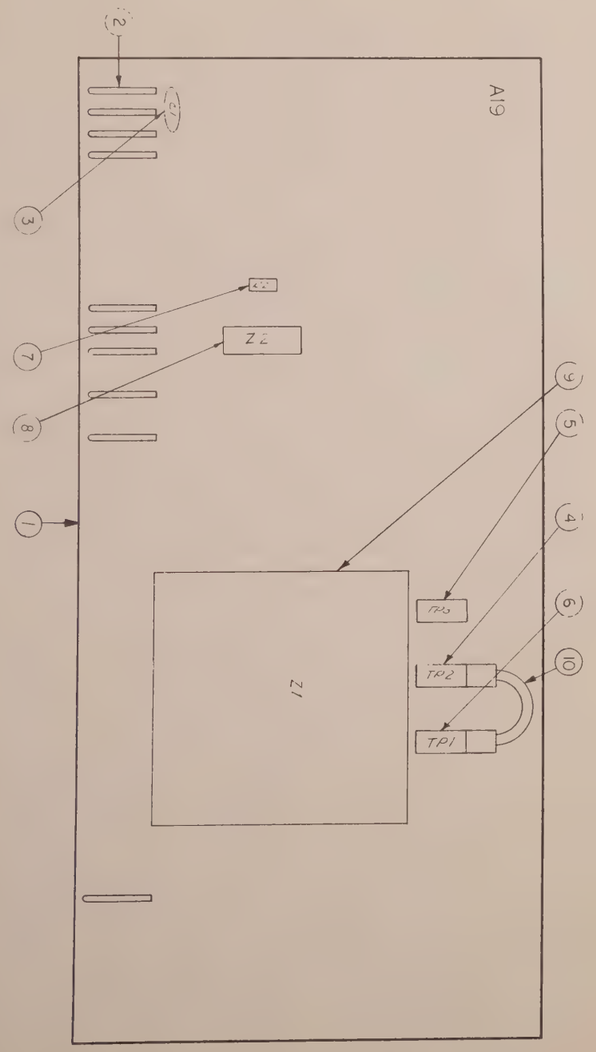
ASSEMBLY 66-6115

PARTS LIST

ASSEMBLY:	Sample and Hold	SCHEMATIC NO.:	66-0815	PART NO.:	66-6115

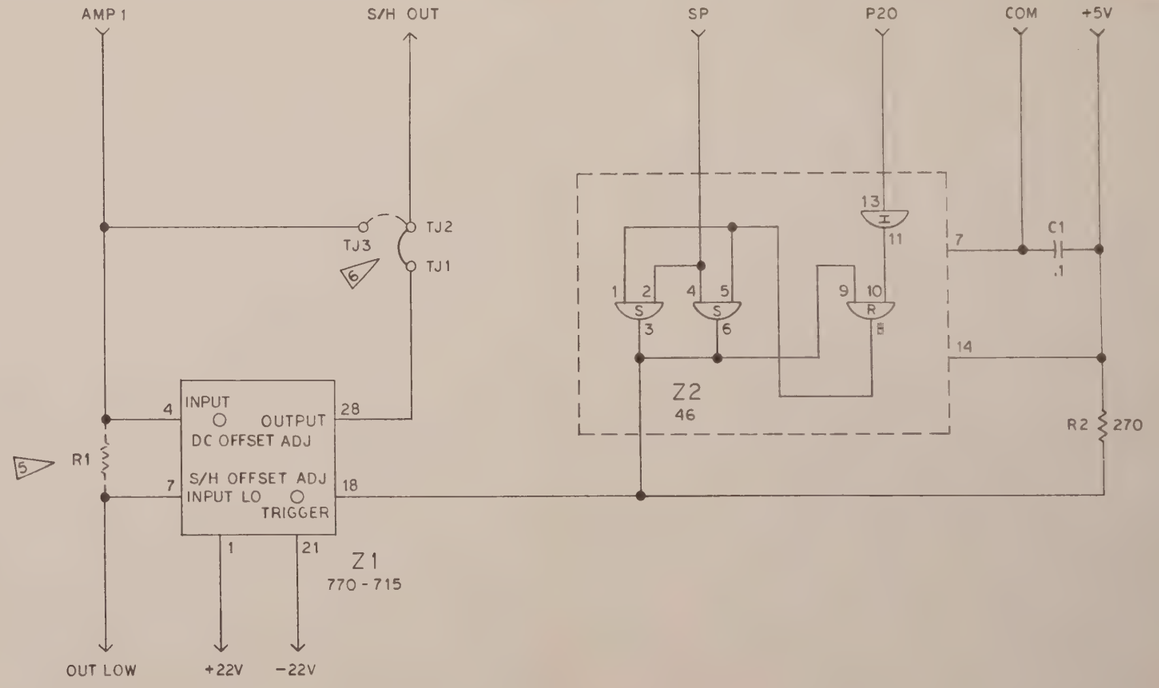
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES (ADD PREFIX A19)	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	CKT BD–ETCHED		66-7115-1		15318
2	10	CONTACT ELECT		2-63904	5001-1923	91662
3	1	CAP CER DISC 0.1 10V	C1	1-57525	HY320	56289
4	1	TEST POINT JACK–RED	TP2	5-19002	TJ-51-2	82042
5	1	TEST POINT JACK–BROWN	TP1	5-19004	TJ-51-4	82042
6	1	TEST POINT JACK–ORANGE	TP3	5-19006	TJ-51-6	82042
7	1	RES COMP 270	R2	7-41236	RC07GF271J	MIL-R-11
8	1	IC QUAD 2 INPUT GATE	Z2	7-96008	MC-846P	15873
9	1	SAMPLE AND HOLD	Z1	7-96043	770-715	14991
10	1	JUMPER		76-2017-1		15318

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.



NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A19

Figure 6-32. Sample and Hold Assembly.



6 JUMPER NORMALLY INSTALLED BETWEEN TJ1 AND TJ2 FOR S/H OPERATION. TO BYPASS S/H OPERATION JUMPER TJ2 TO TJ3

5 TERMINATION RESISTOR NOT NORMALLY INSTALLED

4. R2,C1,Z2 | NONE
   LAST NUMBER USED | NUMBER NOT USED
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A19
2. ALL CAPACITORS ARE IN MF
1. ALL RESISTORS ARE IN OHMS, ±5%, ¼W

NOTES: UNLESS OTHERWISE SPECIFIED:

Diagram 31. Sample and Hold Schematic.

MASTER ASSEMBLY

PARTS LIST

ASSEMBLY: End Item	SCHEMATIC NO.: 66-0820	PART NO.: 66-1030

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	MAIN CHASSIS SUBASSEMBLY		66-5035		15318
2	1	INPUT AMP/DECODER ASSEMBLY	A6,A8	66-5036		15318
3	1	REFERENCE AMP ASSEMBLY	A7	66-6112-3		15318
4	1	PROGRAM CONTROL ASSEMBLY	A4	66-6136-1		15318
5	1	DECADE ASSEMBLY	A5	66-6074-1		15318
6	1	DISPLAY DRIVER NO. 2 ASSY	A2	66-6118-1		15318
7	1	DISPLAY DRIVER NO. 1 ASSY	A1	66-6075-1		15318
8	1	POWER SUPPLY & FILTER ASSY	A9	66-6078-3		15318
9	1	FRONT PANEL SUBASSEMBLY		66-5032-1		15318
10	1	REAR PANEL SUBASSEMBLY		66-5033-1		15318
11	2	SPRING LATCH		00-0503-1		15318
12	2	GUIDE–BOTTOM		00-2000-1		15318
13	2	GUIDE–TOP		00-2001-1		15318
14	2	BRACKET–RACK MTG		00-2002-1		15318
15	2	COVER–FRONT		00-2005-1		15318
16	2	COVER–REAR		00-2009-1		15318
17	2	COVER–TOP & BOTTOM		00-2010-1		15318
18	2	LATCH		00-2012-1		15318
19	2	COVER–SIDE		00-2013-1		15318
20	2	SIDE PANEL		00-2003-1		15318
21	2	HANDLE		00-2007-1		15318
22	1	SHIELD–TOP		66-2164-1		15318
23	1	SHIELD–BOTTOM		66-2155-1		15318
24	1	TOOL–EXTRACTION		70-9500-1		15318
25	1	KNOB		5-42006	7CC2S2	Not Known
26	1	BAIL 16"		8-16504		Not Known
27	1	COVER PLATE–REAR		66-2162-1		15318
28	2	BEZEL		00-2006-1		15318
29	1	SAMPLE AND HOLD ASSY	A19	66-6115-1		15318
30	1	INPUT SELECTOR ASSY	A10	66-6117-3		15318
31	1	AUTORANGE	A3	66-6119-3		15318
32	1	PRINT CONTROL	A12	66-6137-1		15318
33	1	BCD PRINT OUTPUT NO. 1 ASSY	A14	66-6130-1		15318

PARTS LIST

ASSEMBLY: End Item			SCHEMATIC NO.: 66-0820		PART NO.: 66-1030	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
34	1	BCD PRINT OUTPUT NO. 2 ASSY	A15	66-6131-1		15318
35	1	BCD VOLTAGE STATE NO. 1 ASSY (–12)	A14	66-6128-1		15318
36	1	BCD VOLTAGE STATE NO. 2 ASSY (–12)	A15	66-6129-1		15318
37	1	BCD VOLTAGE STATE NO. 1 ASSY (+12)	A14	66-6121-1		15318
38	1	BCD VOLTAGE STATE NO. 2 ASSY (+12)	A15	66-6122-3		15318
39	1	10-LINE PRINT OUTPUT NO. 1 ASSY	A14	66-6123-1		15318
40	1	10-LINE PRINT OUTPUT NO. 2 ASSY	A15	66-6124-1		15318
41	1	10-LINE PRINT OUTPUT NO. 3 ASSY	A16	66-6125-1		15318
42	1	DTL PRINT OUTPUT NO. 1 ASSY	A14	66-6126-1		15318
43	1	DTL PRINT OUTPUT NO. 2 ASSY	A15	66-6127-1		15318
44	1	REMOTE BUFFER NO. 1 ASSY	A17	66-6132-1		15318
45	1	REMOTE BUFFER NO. 2 ASSY	A18	66-6133-1		15318
46	1	REMOTE NO. 1 ASSY	A17	66-6134-1		15318
47	1	REMOTE NO. 2 ASSY	A18	66-6135-1		15318
48	1	CONNECTOR–REAR INPUT ASSY		66-5044-1		15318
49						
50	1	MV/OHMS CONVERTER ASSY	A11	56-6014-1		15318
51	1	AC CONVERTER ASSY	A13	57-6000-7		15318
		OR				
		RMS CONVERTER ASSY	A13	57-6001		15318
52	1	RACK SLIDE (OPTION)		00-5003-1		

PARTS LIST

SUBASSEMBLY: Front Panel			SCHEMATIC NO.:		PART NO.: 66-5032	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	PANEL–FRONT		66-2152-B		15318
2	1	BRACKET–POT MTG		67-2046-1		15318
3						
4	1	POLARIZER		67-2058-1		15318
5	5	CLIP–"C"–LAMP MTG		2-05004	10905-01	03797
6	5	LAMP		5-46507	CF02-WTS-1730	03797
7	1	BANANA JACK–BLACK NYLON		6-94013	221	83330
8	1	BANANA JACK–RED NYLON		6-94014	221	83330
9	1	BANANA JACK–GREEN NYLON		6-94015	221	83330
10	1	BANANA JACK–YELLOW NYLON		6-94016	221	83330
11	1	BANANA JACK–BLUE NYLON		6-94017	221	83330
12	1	BANANA JACK–GROUND		6-94018	101	83330
13	1	SNAP BUSHING, NYLON		1-25901		
SUBASSEMBLY: Rear Panel					**PART NO.:** 66-5033	
1	1	PANEL–REAR		66-2153-1		15318
2	1	RETAINER–CKT BD		66-2156-1		15318
3	1	POWER CORD		2-70004	C2103-076-GY	80126
4	1	FAN		3-60003	MDL 3000	NONE
5	1	FUSE–SLO BLO 3 AG 1 AMP		4-08017	313.001	75915
6	1	FUSE HOLDER		4-12000	342.004	75915
7	1	POWER CORD STRAIN RELIEF		4-35000	SR-6P-1	28520
8	1	SWITCH–SLIDE (115/220)		8-65004	11A-1016	82389
9	1	SNAP HOLE PLUG 7/8" DIA.		6-88002	7315	00194
ASSEMBLY: Rear Input Connector					**PART NO.:** 66-5044	
1	1	RECEPTACLE BNC		2-52007	KPT 7A12-8PAY	71468
2	1	TUBING CLEAR		9-07514	PVC-105/14	70331
3	2	SING COND SHIELDED		9-80014	HX241936STJ	99114

PARTS LIST

ASSEMBLY: Main Chassis					PART NO.: 66-5035	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	MASTER BOARD SUBASSEMBLY		66-6120-1		15318
2	1	FRAME SUBASSEMBLY		66-5031-1		15318
3	1	POWER TRANSISTOR SUBASSEMBLY		66-5034-1		15318
4	2	ANGLE		12-2003-1		15318
5	1	STRAP TOOL HOLDER		70-3005-1		15318
6	1	NYLON GROMMET		6-36707	212-160404-08	02768
7	8	NYLON GROMMET		6-36709	212-180402-29	02768
SUBASSEMBLY: Master Board					**PART NO.:** 66-6120	
1	1	CKT BD–ETCHED		66-7120-A		15318
2	538	CONTACT–ELECT		2-63905	5201-0223	91662
3	1	POWER TRANSFORMER	T1	66-0512-1		15318
4	1	POWER SWITCH & RATE POT	S1	66-0516-1		15318
5	1	CAP ELECT 3X150 250V	C1	1-58016	505-2624-02	00853
6	1	RES COMP 470K 1/2W 5%	R3	66-0515	6010L-1-203	72314
7	1	RES VAR WW 50	R1	7-41075	RC20GF474J	MIL-R-11
8	1	RES VAR WW 20K	R2	7-54260	6010L-1-500	72314
9	4	SEMICOND DIODE	CR1-CR4	7-95659	MR1030B	JEDEC
10	5	SOCKET–LAMP		8-24112	Q-082-2K	03797
11	1	SWITCH 1 SECT 6 POLE PP	S7	8-64140	SERIES "E"	05464
12	2	SWITCH 6 SECT 1-6 INTLK	S3,S4	8-64141	SERIES "E"	05464
13	1	SWITCH 3 SECT 1-3 INTLK	S2	8-64142	SERIES "E"	05464
14	1	SWITCH 4 SECT 1-3 INTLK 4 MOM	S5	8-64155	SERIES "E"	05464

NOTE: Unless otherwise specified, all resistors are in ohms, ±5%, 1/4W. All capacitors are in microfarads.

PARTS LIST

SUBASSEMBLY: Frame					PART NO.: 66-5031	
ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES	CIMRON PART NO.	MIL OR VENDOR PN	CODE OR SPEC NO.
1	1	SHIELD–FRONT		66-2143-1A		15318
2	1	TRACK–RH		66-2144-1A		15318
3	1	TRACK–REAR		66-2145-1A		15318
4	1	TRACK–FRONT		66-2147-1A		15318
5	1	SHIELD–REAR–LH		66-2148-1A		15318
6	1	SUPPORT–REAR		66-2149-1A		15318
7	1	TRACK–SIDE–LH		66-2150-1A		15318
8	1	SHIELD–SIDE–RH		66-2151-1A		15318
9	1	BRACKET–RATE POT		66-2158-1		15318
10	2	BLOCK–INSULATOR		66-2159-1		15318
SUBASSEMBLY: Power Transistor					**PART NO.:** 66-5034	
1	1	SHIELD–REAR		66-2146-1		15318
2	1	TRANSISTOR		9-04729	2N3055	JEDEC
3	2	TRANSISTOR		9-04739	2N3054	JEDEC

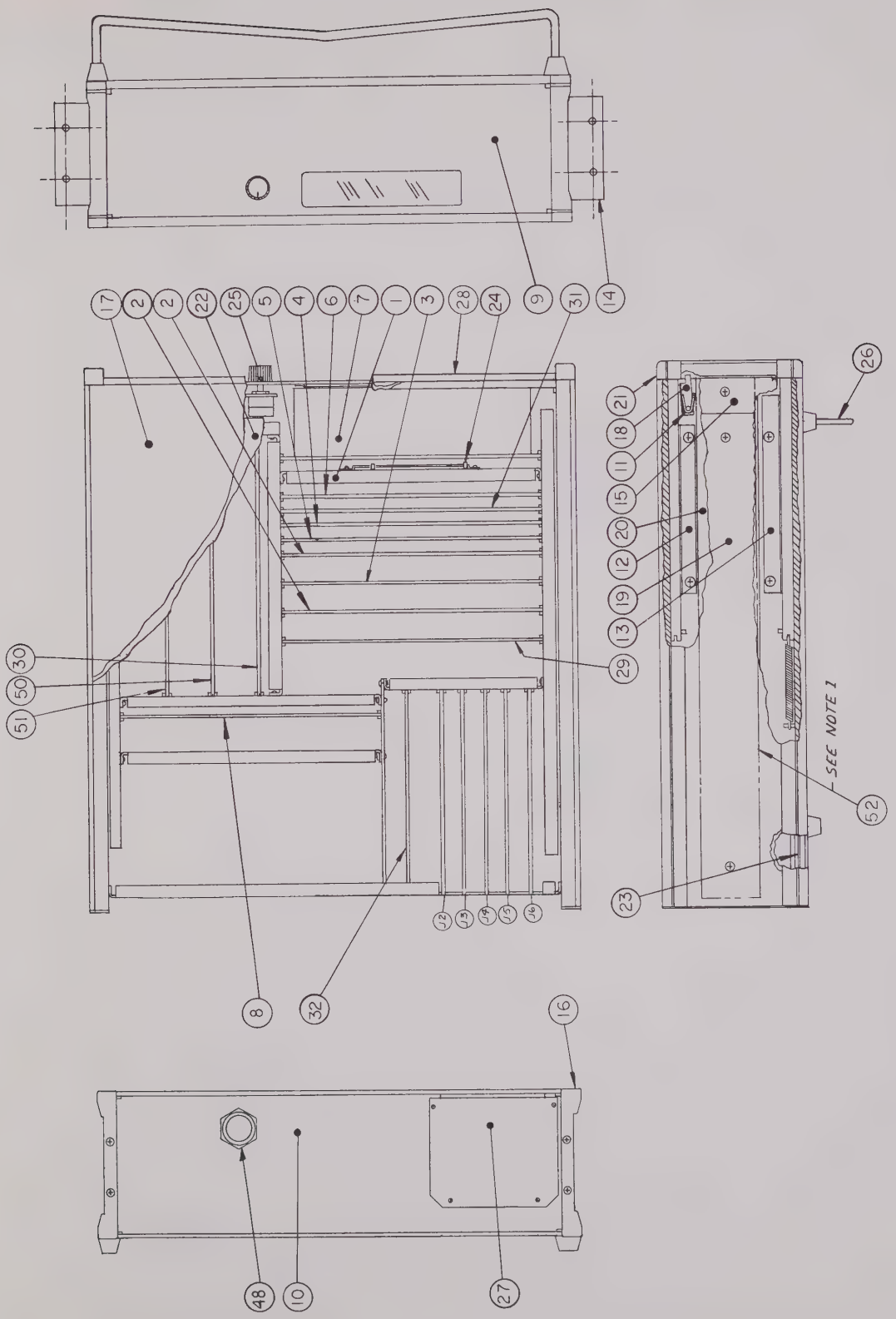


Figure 6-33. End Item.

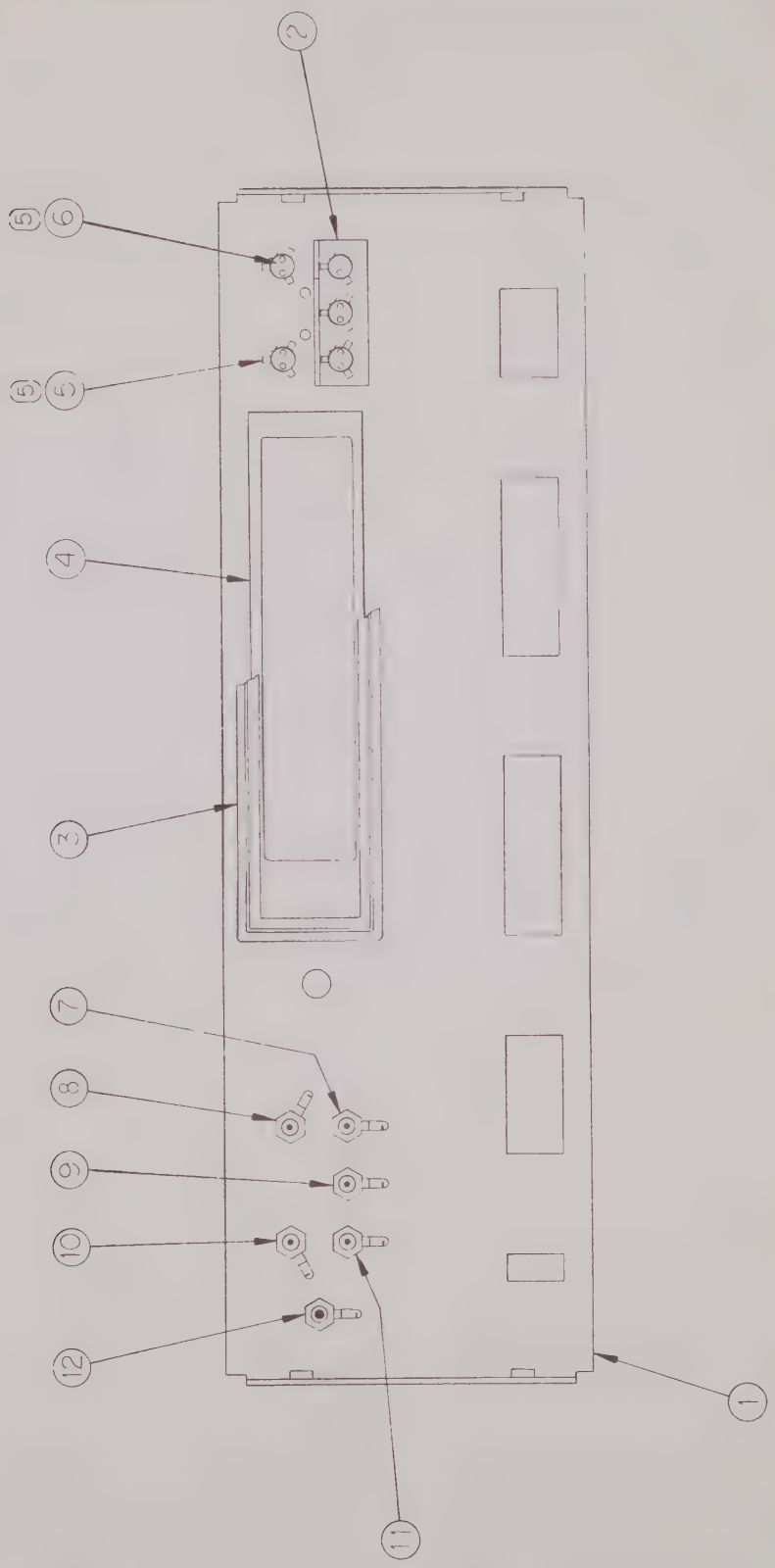


Figure 6-34. Front Panel Subassembly.

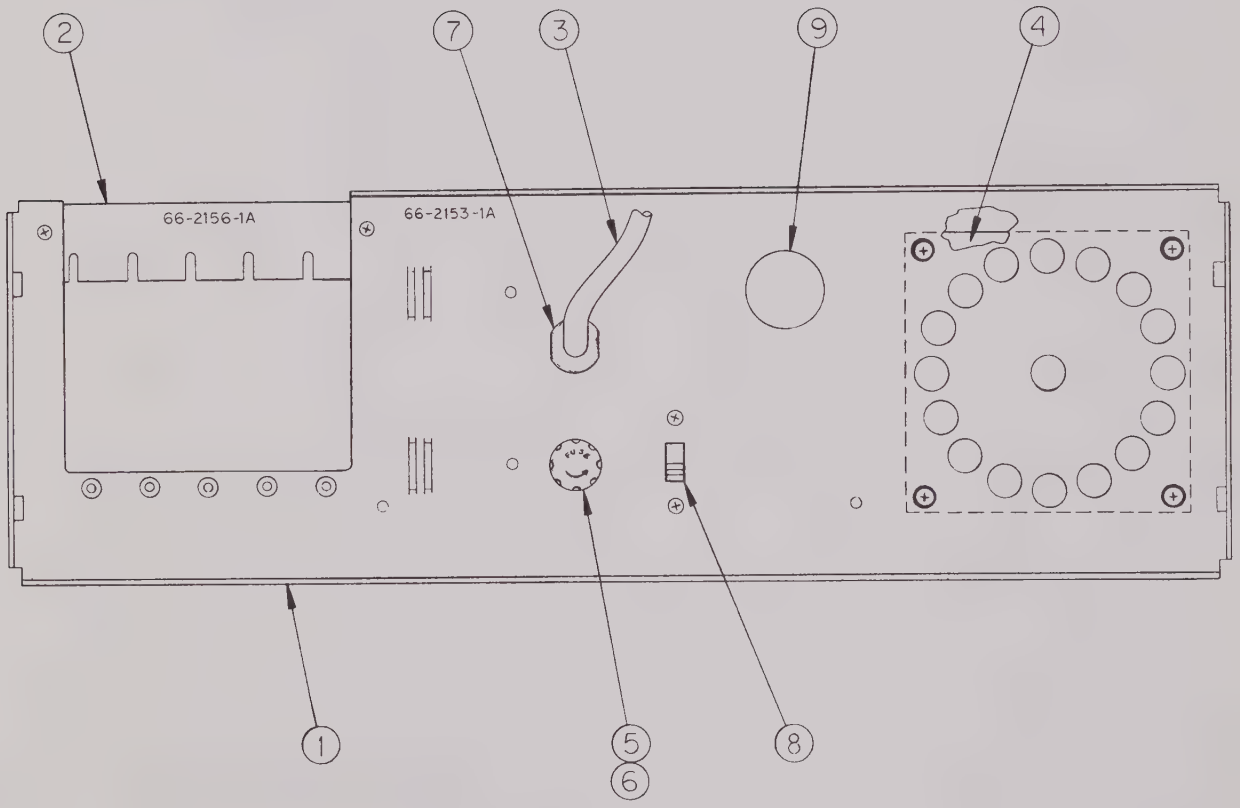


Figure 6-35. Rear Panel Subassembly.

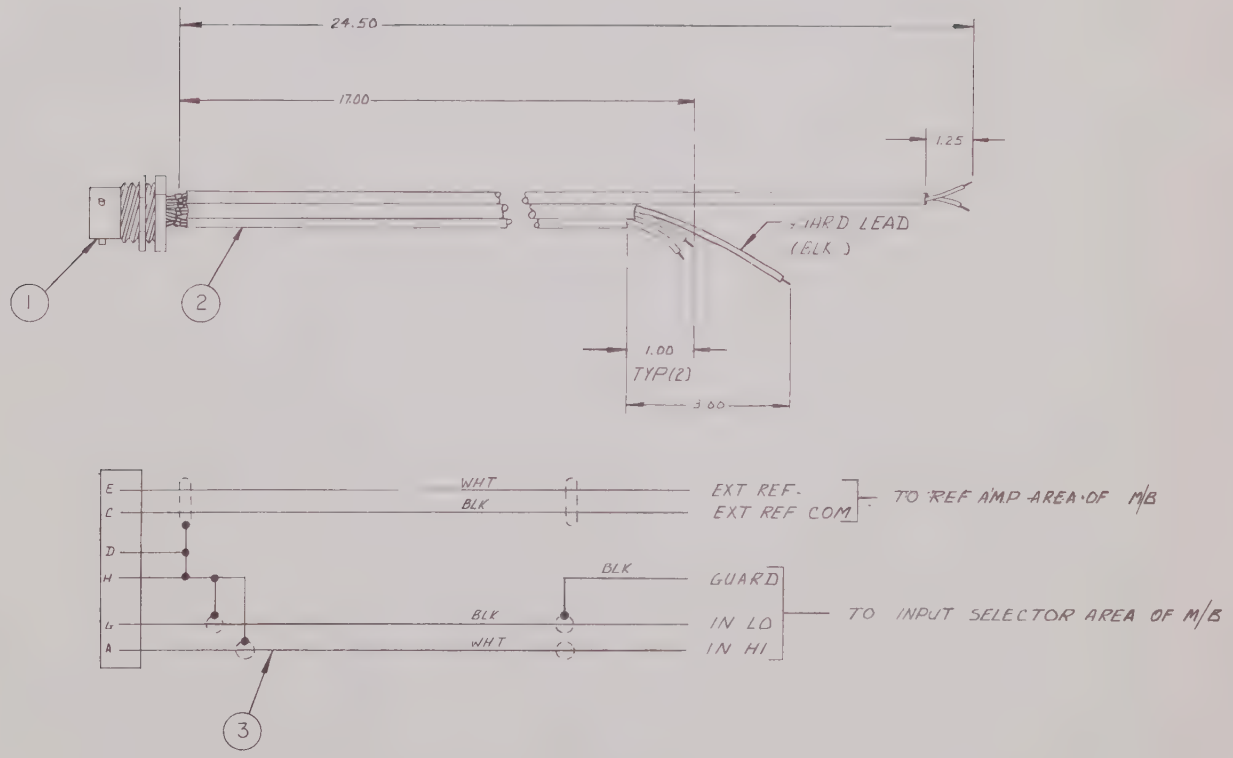


Figure 6-36. Rear Input Connector Assembly.

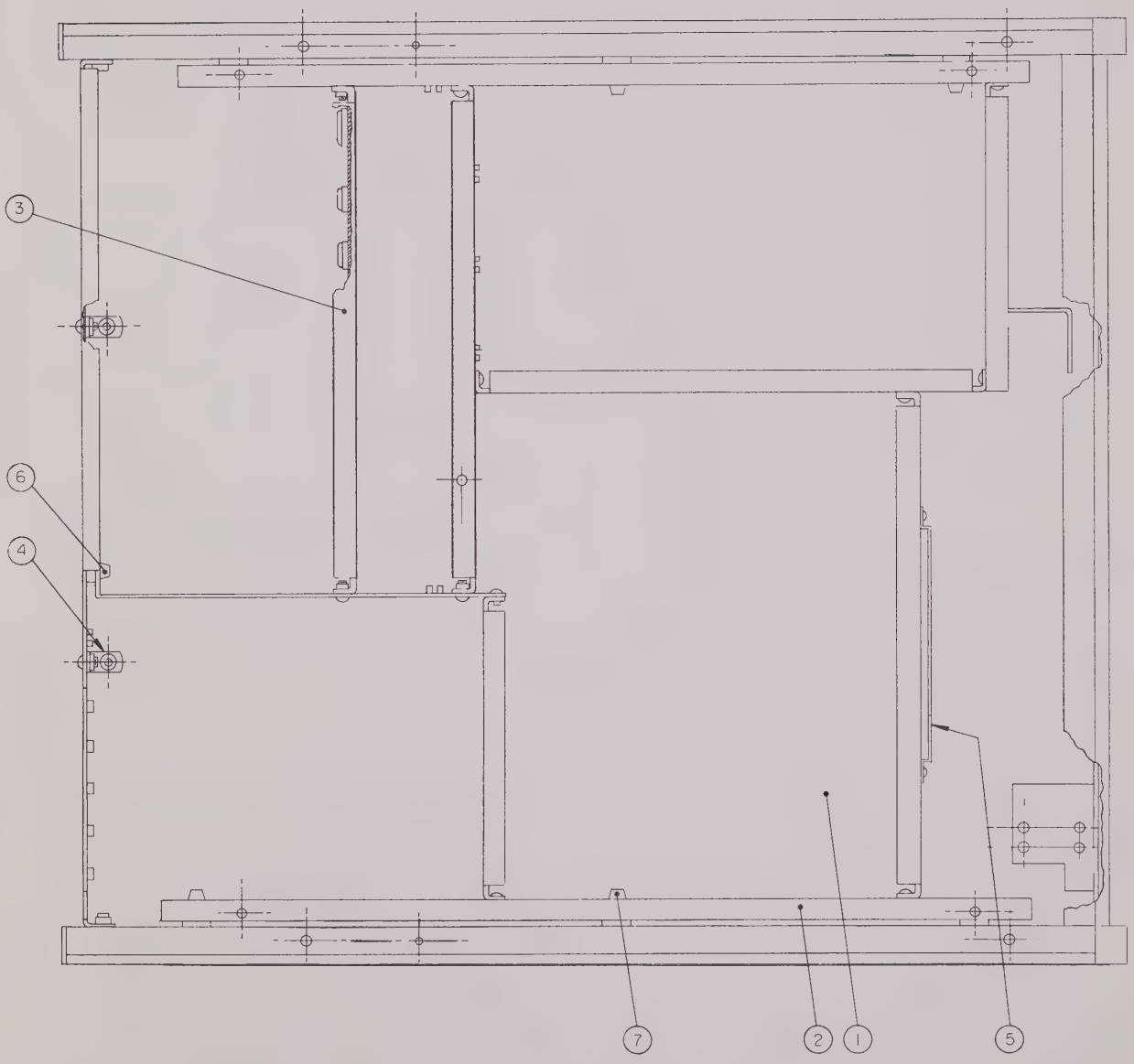


Figure 6-37. Main Chassis Subassembly.

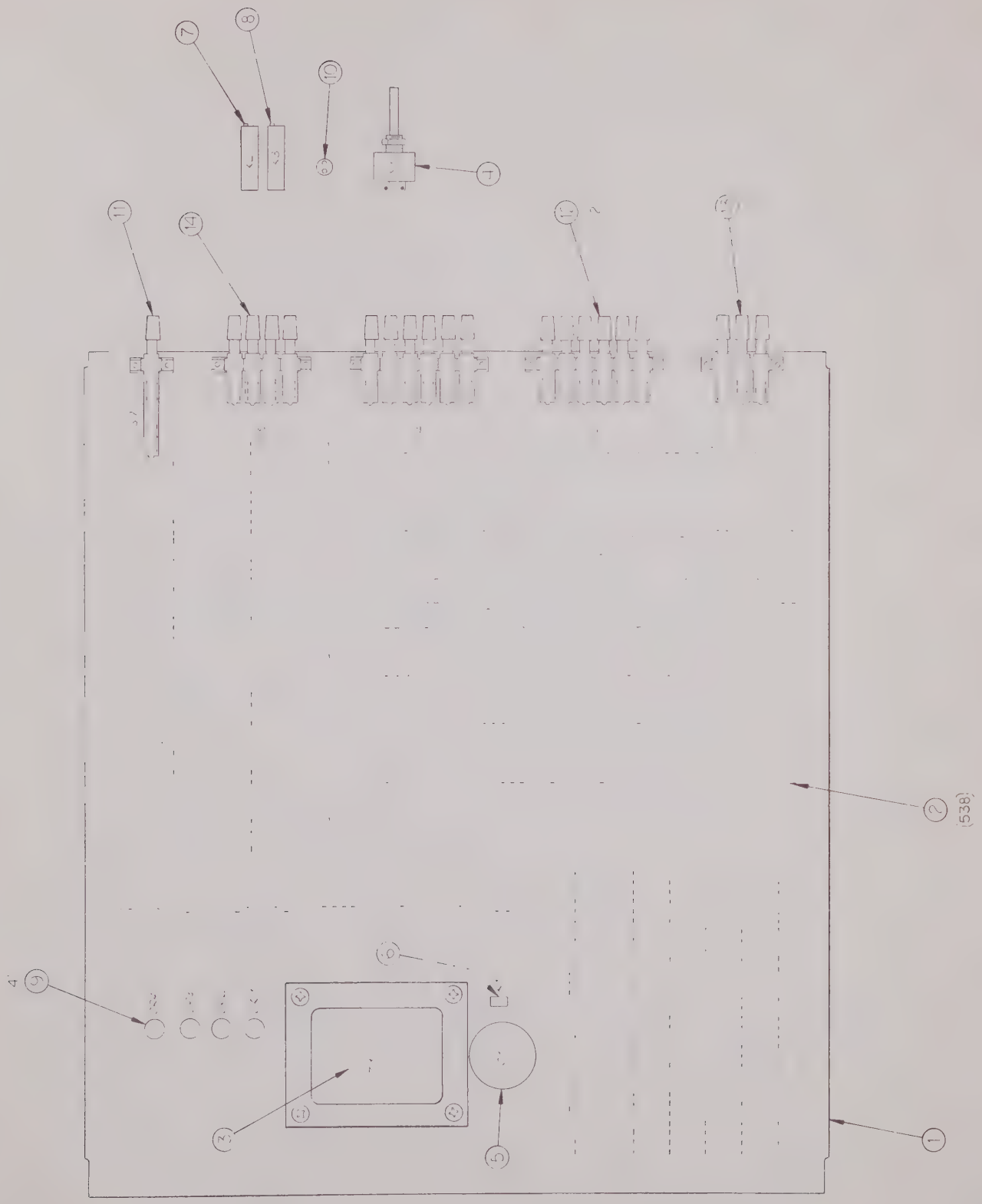


Figure 6-38. Master Board Subassembly.

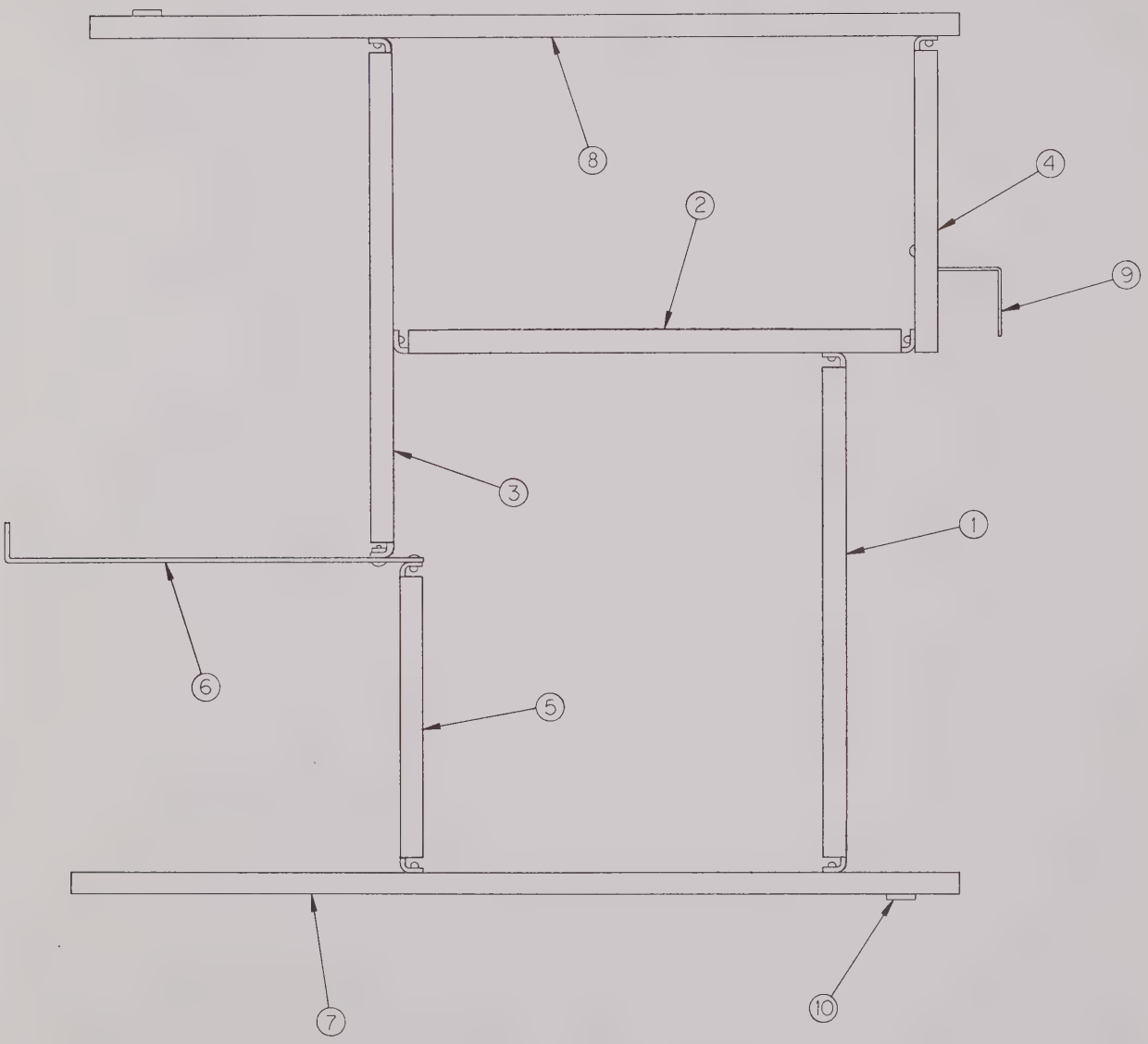


Figure 6-39. Frame Subassembly.

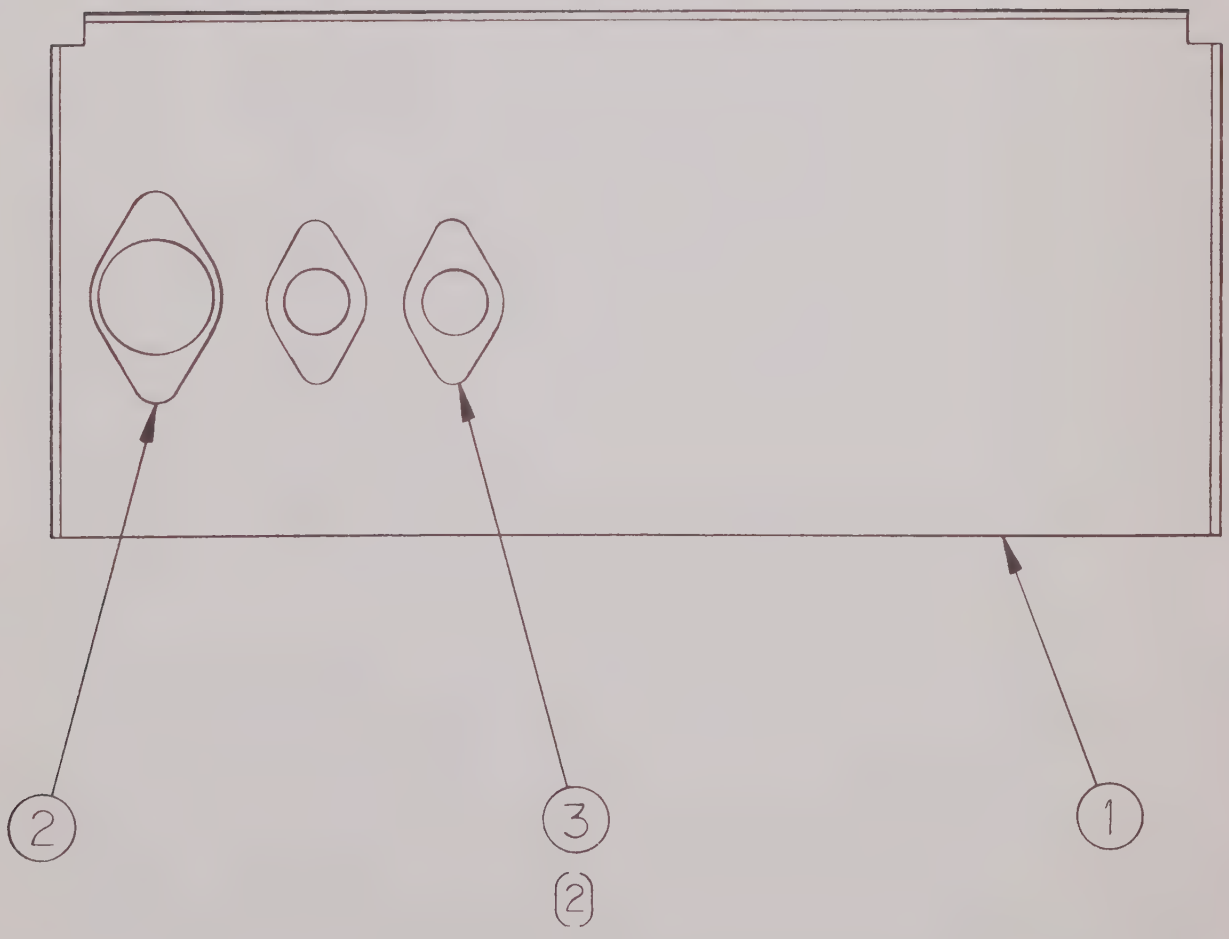


Figure 6-40. Power Transistor Subassembly.

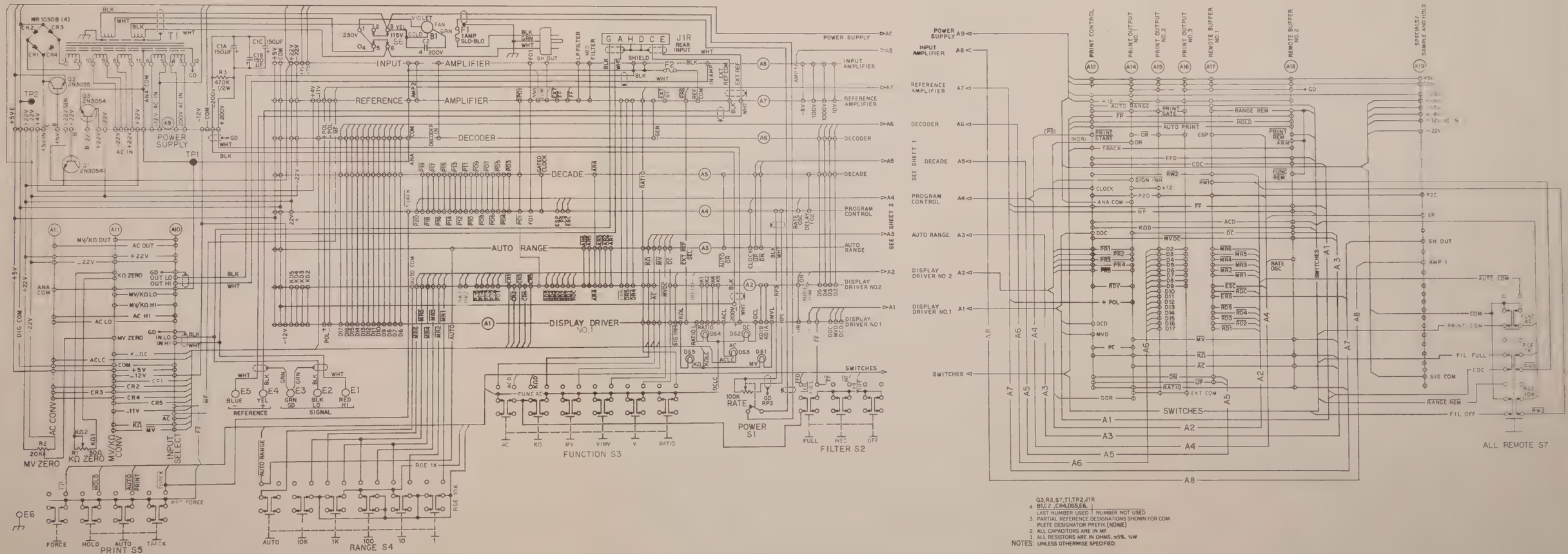


Diagram 32. Master Schematic.

SECTION VII

RECOMMENDED SPARE PARTS

The following is a list of recommended spare parts required to maintain a specific number of instruments at a satisfactory level of performance for one year in an isolated area.

Table 7-1. Recommended Spare Parts.

ASSEMBLY OR PART NAME	PART NUMBER	QUANTITY REQUIRED		
		1 INSTRUMENT	5 INSTRUMENTS	10 INSTRUMENTS
Power Supply and Filter	66-6078	1	3	5
Input Selector	66-6117	1	3	5
AC Converter	57-6000	1	3	5
MV/Ohms Converter	56-6014	1	3	5
Input Amplifier Subassembly	66-6116	1	3	5
Program Control	66-6136	1	3	5
Decade	66-6074	1	3	5
Decoder Subassembly	66-6073	1	3	5
Reference Amplifier	66-6112	1	3	5
Display Driver No. 2	66-6118	1	3	5
Display Driver No. 1	66-6075	1	3	5
Light Subassembly	66-6077	1	3	5
Autorange	66-6119	1	3	5
Print Control	66-6137	1	3	5
DTL Print Output No. 1	66-6126	1	3	5
DTL Print Output No. 2	66-6127	1	3	5
BCD Voltage State No. 1	66-6121	1	3	5
BCD Voltage State No. 2	66-6122	1	3	5
BCD Print Output No. 1	66-6130	1	3	5
BCD Print Output No. 2	66-6131	1	3	5
BCD Voltage State No. 1	66-6128	1	3	5
BCD Voltage State No. 2	66-6129	1	3	5
Ten-Line Print Output No. 1	66-6123	1	3	5

Table 7-1. Recommended Spare Parts. (Cont'd)

ASSEMBLY OR PART NAME	PART NUMBER	QUANTITY REQUIRED		
		1 INSTRUMENT	5 INSTRUMENTS	10 INSTRUMENTS
Ten-Line Print Output No. 2	66-6124	1	3	5
Ten-Line Print Output No. 3	66-6125	1	3	5
Remote No. 1	66-6134	1	3	5
Remote No. 2	66-6135	1	3	5
Remote Buffer No. 1	66-6132	1	3	5
Remote Buffer No. 2	66-6133	1	3	5
Sample and Hold	66-6115	1	3	5
Input Cable	66-5013	1	2	3
Reference Cable	66-5014	1	2	3
Fuse, 1 ampere, SLO-BLO	4-08017	5	5	10
Fuse Resistor, 2 KΩ, 5%	4-09014	5	5	10
Fuse Resistor, 100Ω, 1%	4-09013	5	5	10
Extraction Tool	70-9500-1	1	3	5
Extension Board	66-9500-1	1	1	2

APPENDIX

TABLE OF CONTENTS

Section	Page
ABBREVIATIONS	A-2
MANUFACTURERS	A-3
WARRANTY	

LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATION	WORD
AC	alternating current
AMP	ampere
B	bel
CAP	capacitor
CARB	carbon
CER DISC	ceramic disc
CKT BD	circuit board
COM	common
COMP	composition
CONN	connector
da	deka 10^{1}
DC	direct current
DEP	deposited
DIP	dipped
DPDT	double pole double throw
DVM	digital voltmeter
DVRM	digital volt-ratio-meter
ELEC	electric, electrical
ELECT	electrolytic
F	farad
FET	field effect transistor
Hz	hertz
JEDEC	Joint Electronic Device Engineering Council
k	kilo, 10^{3}
lb	pound
m	milli, 10^{-3}
M	mega, 10^{6}
MAX	maximum
MED	medium
MET	metallized
MIN	minimum
MTG BKT	mounting bracket
MY	mylar

ABBREVIATION	WORD
n	nano, 10^{-9}
NC	normally closed
Ne	neon
NO	normally open
p	pico, 10^{-12}
P	paper
POL	pole
POLYCARB	polycarbonate
POLYSTY	polystyrene
POS	position
POT	potentiometer
PP	peak-to-peak
PPM	parts per million
REC	receptacle
RECT	rectangular
RES	resistor
rms	root mean square
SIL	silver
SPDT	single pole double throw
SPST	single pole single throw
STD	standard
TANT	tantalum
TRIM	trimmer
V	volt
VA	voltampere
VAR	variable
W	watt
WW	wirewound
°C	degrees Celsius
°F	degrees Fahrenheit
°K	degrees Kelvin
μ	micro, 10^{-6}
Ω	ohm

LIST OF MANUFACTURERS

CODE TO NAME

FEDERAL SUPPLY CODE	MANUFACTURER	ADDRESS
00194	Walsco Electronics Corp.	Los Angeles, California
00853	Sangamo Electric Company	Pickens, South Carolina
01295	Texas Instruments, Inc.	Dallas, Texas
01686	RCL Electronics, Inc.	Manchester, New Hampshire
02768	Fastex Division of Illinois Tool Works	Des Plaines, Illinois
03797	Eldema Corp.	Compton, California
03888	Pyrofilm	Cedar Knolls, New Jersey
04062	Elmenco Products Company	New York, New York
05347	Ultronix, Inc.	San Mateo, California
05464	Industrial Electronic Engineer Inc.	North Hollywood, California
05704	Alac, Inc.	Glendale, California
06751	U.S. Semcor Div. of Nuclear Corp.	Phoenix, Arizona
07088	Kelvin Electric Company	Van Nuys, California
07115	Corning Glass, Electronic Components	Bradford, Pennsylvania
07716	International Resistance Company	Burlington, Iowa
08806	Miniature Lamp Department GECO	Cleveland, Ohio
12406	Elpac, Inc.	Fullerton, California
12617	Hamlin, Inc.	Lake Mills, Wisconsin
14655	Cornell-Dubilier Electric Corp.	Newark, New Jersey
14752	Electro Cube, Inc.	South Pasadena, California
14991	Redcor Development Company	Canoga Park, California
15318	Cimron Div. of Lear Siegler, Inc.	San Diego, California
15636	Elec-Trol, Inc.	Northridge, California
15873	Motorola, Inc.	Arcade, New York
17838	Mektron Div. of California General	Chula Vista, California
24796	Parelco, Inc.	El Monte, California
28520	Heyman Mfg. Company	Kenilworth, New Jersey
27556	IMB Electronics	Santa Fe Springs, California
49671	RCA	New York, New York
56289	Sprague Electric Company	North Adams, Massachusetts

LIST OF MANUFACTURERS (Cont'd)

CODE TO NAME

FEDERAL SUPPLY CODE	MANUFACTURER	ADDRESS
70331	Alpha Wire Corporation	New York, New York
71468	ITT Cannon Electric Company	Los Angeles, California
71590	Centralab, Div. of Globe Union, Inc.	Milwaukee, Wisconsin
72314	Fairchild Camera and Instrument Corp.	Syosset, LI, New York
73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, California
73899	JFD Electronics Corporation	Brooklyn, New York
75915	Littelfuse, Inc.	Des Plaines, Iowa
80294	Bourns Laboratories, Inc.	Riverside, California
82042	Carter Precision Electric Company	Skokie, Illinois
82389	Switchcraft	Chicago, Illinois
83330	Smith, Herman H., Inc.	Brooklyn, New York
90201	Mallory, PR and Co., Inc.	Detroit, Michigan
91662	Elco Pacific	Los Angeles, California
92379	Burroughs Corp.	Chicago, Illinois
93656	Electric Cord Supply	Caldwell, New Jersey
95348	Gordos Corp.	Bloomfield, New Jersey
96733	San Fernando Electric Mfg. Co.	San Fernando, California
99114	Hi-Temp Wires, Inc.	Westbury, New York

IMPORTANT

Include the instrument model number and serial number in any correspondence regarding this instrument. The serial number must match the instrument serial number if parts are to be ordered from the manual. Your help in this will enable us to answer your inquiries and fill your order with the least possible delay.

WARRANTY

All CIMRON instruments are fully warranted to be free from defects in material and workmanship for a period of one year as per CIMRON's standard terms and conditions of sale. This warranty does not, however, cover tubes, transistors, choppers, fuses and/or batteries. Mechanical stepping switches are guaranteed for ninety days provided they have been lubricated in accordance with manufacturers instructions.

Should replacement parts be required, whether at no charge under warranty or at established net prices, notify us promptly, including sufficient details to identify the required parts. We will ship them (SHIPPING CHARGES COLLECT) as soon as possible, usually within twenty-four hours.

In the event factory service or assistance is required for this instrument:

1. Give CIMRON's Customer Service Department prompt notice in writing of the nature of any suspected defects.

2. Upon receipt of written authorization and shipping instructions from CIMRON, return the instrument (TRANSPORTATION CHARGES PREPAID) to CIMRON's main plant located at 1152 Morena Boulevard, San Diego, California 92110. The instrument will be returned to the customer TRANSPORTATION CHARGES COLLECT.

3. CIMRON will acknowledge receipt of the instrument and indicate warranty status. No charge will be made for repairs covered by terms of this warranty OTHER THAN TRANSPORTATION CHARGES.

4. In the event repairs are "out of warranty", CIMRON will provide the customer with a quotation which will require the customer's approval before the work can be accomplished. Return of the instrument to the customer shall be with TRANSPORTATION CHARGES COLLECT.

CIMRON reserves the right to adjust the prices and make design modifications without notice.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it does not operate or is damaged, a claim should be filed with the carrier. A copy of the claim should be sent to CIMRON. Upon receipt of the claim we will advise you of the disposition to be made of the instrument and arrangements will be made for repair or replacement. Do not return an instrument to CIMRON without prior approval.

The above statements and warranty constitute a part of our Standard Terms and Conditions of Sale as published in our order acknowledgement which is CIMRON's Warranty in its entirety.

LEAR SIEGLER, INC.

CIMRON DIVISION,
1152 MORENA BOULEVARD,
SAN DIEGO, CALIFORNIA 92110

ELECTRONICS FOR MEASUREMENT - CONTROL - AUTOMATION